FINAL

ENVIRONMENTAL ASSESSMENT FOR FLIGHT TEST TO THE EDGE OF SPACE

December 2008

95th Air Base Wing
Environmental Management Directorate
Edwards Air Force Base, California

FINAL FINDING OF NO SIGNIFICANT IMPACT/SUMMARY FINAL ENVIRONMENTAL ASSESSMENT FOR FLIGHT TEST TO THE EDGE OF SPACE

1.0 INTRODUCTION

This Environmental Assessment (EA) evaluates the potential environmental impacts associated with conducting up to 48 flight tests at very high altitudes (up to 264,000 feet above mean sea level [MSL]) over the western United States and off the west coast of the United States. These flight tests would reach speeds faster than the speed of sound (in excess of Mach 1) and land at Edwards Air Force Base (AFB), California.

This project was analyzed and documented in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended (42 United States Code, Section 4321 *et seq.*); the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] 1500–1508); 32 CFR Part 989, *Environmental Impact Analysis Process*; and National Aeronautics and Space Administration (NASA) policy and procedures (14 CFR Part 1216, Subpart 1216.3). The U.S. Air Force Flight Test Center is representing the Department of Defense (DOD) as the lead agency. NASA Dryden Flight Research Center is a cooperating agency in the preparation of this EA.

This programmatic EA serves as the foundation for environmental processes required for a first flight in 2011 and would be re-evaluated after 2015. This EA addresses the launch, inflight, and landing phases of the intended test vehicle program at Edwards AFB. Analyses of other phases (e.g., vehicle fabrication and refurbishment) are the responsibility of the intended test vehicle program office. Edwards AFB is a cost-effective location for testing and landings because of its facilities, its remote location, and previous successes in its use for developmental and experimental vehicle flights and landings.

2.0 DESCRIPTION OF THE PROPOSED ACTION

Alternative A, the Proposed Action, is to conduct test and operational flights by high-speed vehicles that operate at altitudes above 30,000 feet MSL up to the edge of space; and travel over the eastern Pacific Ocean and the western United States from the Pacific Ocean to the eastern borders of Texas, Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota; and land at Edwards AFB. These vehicles could be launched from any DOD or NASA installation or from any spaceport, or they could be air-launched from a carrier aircraft. Under Alternative B, high-speed vehicle flights would only occur over the Pacific Ocean except for the launch and landing phase of the flight. Under Alternative C, flights would occur over the western United States, from west of the Rocky Mountains to the Pacific Coast and from the Canadian border to Mexico. Flight tests under Alternative D would only occur over portions of the western United States including California, Nevada, Utah, Arizona, New Mexico, Colorado, Wyoming, Texas, Oklahoma, Kansas, Nebraska, and South Dakota. Alternative E would be a computer simulation of the flight trajectories over the entire region. Alternative F (No-Action Alternative) is the status quo where high speed testing is done on an ad hoc basis mostly over the eastern Pacific Ocean.

3.0 SUMMARY OF ENVIRONMENTAL IMPACTS

3.1 NOISE

The noise impact for this proposed project would result from the sonic boom created by the flight vehicle as it accelerated up to Mach 7.0 (based on analyzed trajectories) and cruised toward or away from Edwards AFB. The sonic boom would be heard for less than 1 second over any location along the flight path with an intensity of 0.2–0.6 pounds per square foot (psf). A sonic boom with an intensity of 0.6–2.0 psf would also be heard over approximately 12 percent of the trajectory being used. Four areas on the ground near the launch point, totaling less than 0.0000021 percent of the region of influence (2,500 of 1,179,502,720 acres [number of acres for the states listed in Alternative A]) would experience a sonic boom with intensity of 2.0–3.1 psf (Figure 3-3). The chances are small that noise from the sonic boom would be heard by many people on the ground because the flight path would occur over sparsely populated areas to the maximum extent possible and future flight paths would be required to avoid sensitive areas.

As shown in the *Final Programmatic Environmental Impact Statement for Horizontal Launch and Reentry of Reentry Vehicles* released by the Federal Aviation Administration (FAA) in 2005, sonic booms with intensity of 2.0 psf and below do not create any significant impacts on the environment. Therefore, for the purposes of this EA, only those areas where the intensity would be above 2.0 psf could potentially experience noise impacts and require site-specific NEPA analysis tiered off this EA. When a specific vehicle is selected and launch points identified then significance would be measured and mitigation measures developed if necessary.

Under the Proposed Action, the maximum number of sonic booms that would occur would average less than one per week, with activity lasting for several months followed by several months of inactivity. This cycle would be repeated over the course of the program. At this frequency and a psf of 3.1, the sound level would be approximately 48.6 C-weighted decibels (dBC). A day-night average sound level of 65 A-weighted decibels and C-weighted day-night average sound level of 61 dBC are considered the threshold noise significance level.

Two factors determine human annoyance to sonic booms: frequency and sound level. Test vehicles would create a sonic boom; however, the intensity and frequency would result in less than 2 percent of the population being highly annoyed. At this intensity, fine glass and artifacts could become further damaged; however, the probability is very low that this would occur.

Wildlife could be startled by the sonic boom. The desert tortoise, Mohave ground squirrel, and bighorn sheep would be in areas beneath the flight path where the sonic boom with an intensity of less than 1.0 psf would occur. Studies have shown that due to the low intensity and duration as well as limited occurrence of these predicted sonic booms, significant impacts on wildlife would not be expected to occur. Appendix B.3 lists many of the studies that show that sonic booms with an intensity less than 3.1 psf would not significantly affect wildlife.

3.2 AIR QUALITY

Air emissions would be approximately 9 to 14 percent of threshold *de minimis* values. Criteria pollutant emissions would not exceed state or federal criteria; the emissions of air toxics would not be significant. Every greenhouse gas has a Global Warming Potential (GWP), a measurement of the impact that particular gas has on 'radiative forcing'; that is, the additional heat/energy which is retained in the Earth's ecosystem through the addition of this gas to the atmosphere. The total carbon dioxide equivalent for this

project would be 2,379.86 metric tons per year. Considering that the California Air Resources Board uses 2,500 metric tons of CO_2 as the threshold for reporting under the Regulation for the *Mandatory Reporting of Greenhouse Gas Emissions* for electricity generation and cogeneration facilities and the emissions for this Proposed Action would be below that threshold value, one could assume that these emissions would be considered less than significant. Although the impact of greenhouse gases resulting from the Proposed Action would be less than significant when compared to the mega-million tons of emissions created by commercial aviation, it is still an issue of global concern. The project is in compliance with the Edwards AFB Carbon Neutral Program and on track to comply with Executive Order (EO) 13423 and the Kyoto Protocols.

3.3 AIRSPACE AND AIR SAFETY

The Proposed Action would result in a small increase in the number of flights at Edwards AFB. The flights related to this Proposed Action would be less than 0.005 percent of the normal flight activity at Edwards AFB and less than 0.0000022 percent of the flight activity occurring within the region of interest. The flight vehicles would be required to meet licensing and reliability standards established by DOD, FAA, and NASA. Coordination with the FAA would be required to establish keep-out zones during the flight tests to ensure other aircraft would not be in harm's way.

3.4 SIGNIFICANCE/MITIGATION MEASURES

3.4.1 Noise

Because the area over which the sonic booms would likely occur is small, by adjusting the launch point for any flight tests, one could be reasonably assured that any sonic boom (with intensity from 0.6–3.1 psf) would not occur over any particularly sensitive resource. The Air Force would adjust flight profiles to minimize the potential for the higher intensity sonic booms. FAA and DOD regulations limit or prohibit flights with speeds above Mach 1 or higher over designated avoidance areas (Air Force Instruction 13-201 and FLIP AP/1B) to avoid noise and sonic boom related issues.

3.4.2 Air Quality

Because the air emissions for this proposed project would be below *de minimis* threshold levels and greenhouse gas emissions would be offset by natural sequestration, pollution prevention activities, and best management practices, the impact on air quality would be less than significant. While specific mitigation measures are not specifically required, the base is actively developing a Carbon Neutral Program in accordance with EO 13423 and the Kyoto Protocols to offset carbon dioxide emissions, which may be attributable to decreased precipitation and higher temperatures expected in the arid desert region at Edwards AFB.

3.4.3 Airspace and Air Safety

Impacts on airspace and air safety would be minimized by coordinating flights times so that high- speed vehicle test flights would occur at other than peak periods and along flight paths that would minimize scheduling conflicts to the maximum extent possible.

4.0 CUMULATIVE EFFECTS

The Proposed Action and Alternatives would not be expected to have any significant cumulative impacts on air quality, airspace management and air safety, noise, or any of the other issues analyzed in this EA. Analysis was completed by reviewing other flight-related actions that may occur in the same geographic area.

4.1 UNAVOIDABLE MINOR ADVERSE IMPACTS

The unavoidable adverse effects for the proposed aircraft operations would be noise, air pollutants from aircraft emissions, and potential bird-aircraft strikes. These effects cannot be avoided if these mission-essential flights are to be conducted. However, none of these effects would be significant, as documented in this EA.

4.2 SHORT-TERM USE OF THE ENVIRONMENT VERSUS LONG-TERM BIOLOGICAL PRODUCTIVITY

Conducting these types of test flights would not directly involve contact or consumption of any biological resources. Noise is the primary effect that would reach the ground; however, there are no known noise impacts to plants or published reports that document significant impacts to wildlife at these noise levels. Studies related to low-level operations indicate minor impacts resulting from "startle reactions" are possible, but the startle reaction does not result in reductions in size of wildlife populations or other long-lasting effects. Aircraft operations may result in bird strikes; however, management techniques minimize the potential for any bird/aircraft strike hazard (BASH), which averages 12 per year for operations at Edwards AFB. Considering that Air Force aircraft are involved in approximately 2,600 BASH events each year[1] in the United States, it could be assumed that 0.005 percent of the events occurring at Edwards AFB would be less than significant.

4.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The proposed action would not involve any physical commitment or consumption of resources. While the proposed project would continue to use airspace when there are sorties, the airspace immediately returns to public availability when released from military use.

5.0 CONCLUSION

Analysis of the Proposed Action and Alternatives concludes that Alternative A best suites the needs of the Air Force because it provided the flexibility necessary to meet any operational test requirement. Alternative B would not support contingency landings for tests conducted during the early stages of the program. Alternatives C and D would support realistic testing, but would limit the flight path. Alternative E would not provide a realistic environment for flight testing and consequently is not recommended as the acceptable Alternative. None of the Alternatives would result in significant impact on the human or natural environment.

[1] Air Force Magazine June 6, 1998 article "Bird Strike!" The Chart Page, Tamar A. Mehuron, Associate Editor.

A finding of No Significant Impact (FONSI) for the Proposed Action and Alternatives has been determined based on the absence of significant impacts to the human environment. Therefore no environmental impact statement will be prepared. Background information that supports the research and development of the FONSI and the EA is on file at Edwards AFB and may be obtained by contacting:

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1 Dec 08
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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

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1. REPORT DATE *(DD-MM-YYYY)*
22-12-2008

2. REPORT TYPE
Final Environmental Assessment

3. DATES COVERED *(From - To)*
July 2005 – December 2008

4. TITLE AND SUBTITLE
Finding of No Significant Impact and
Environmental Assessment for Flight Test to the Edge of Space

Final, December 2008

5a. CONTRACT NUMBER
DACA05-01-D-0005

5b. GRANT NUMBER
N/A

5c. PROGRAM ELEMENT NUMBER
N/A

5d. PROJECT NUMBER
Task Order 68

5e. TASK NUMBER
Task 7

5f. WORK UNIT NUMBER
N/A

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See Section 8.0

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10. SPONSOR/MONITOR'S ACRONYM(S)
95ABW/CEVX, 412TH/DRP (HFTT)
USACOE, CESPK-PD-R

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
N/A

12. DISTRIBUTION / AVAILABILITY STATEMENT
This Final Environmental Assessment is available at the 95 ABW/CEV Technical Library and on the World Wide Web at http://bsx.edwards.af.mil/environmental and http://www.edge-of-space.org. Additional distribution is listed in Appendix D.

13. SUPPLEMENTARY NOTES
None.

14. ABSTRACT
This report analyzes the potential environmental affects and consequences for conducting up to 48 annual flight tests by one of a kind research aircraft that would use scramjet engines to fly at altitudes up to 264,000 feet above sea level. These flights would reach speeds faster than the speed of sound and land at Edwards Air Force Base, California.

15. SUBJECT TERMS
Faster than the Speed of Sound, Test Vehicle, Air Breathing Engine, Edwards AFB, Noise and Sonic Boom Analysis, Quantitative Risk Analysis

16. SECURITY CLASSIFICATION OF: Unclassified			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			Dr. Dan Reinke
Unclassified	Unclassified	Unclassified	SAR	174	**19b. TELEPHONE NUMBER** *(include area code)* 661-277-9080

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

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8. PERFORMING ORGANIZATION REPORT NUMBER. Enter all unique alphanumeric report numbers assigned by the performing organization, e.g. BRL-1234; AFWL-TR-85-4017-Vol-21-PT-2.

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FINAL FINDING OF NO SIGNIFICANT IMPACT/SUMMARY FINAL ENVIRONMENTAL ASSESSMENT FOR FLIGHT TEST TO THE EDGE OF SPACE

1.0 INTRODUCTION

This Environmental Assessment (EA) evaluates the potential environmental impacts associated with conducting up to 48 flight tests at very high altitudes (up to 264,000 feet above mean sea level [MSL]) over the western United States and off the west coast of the United States. These flight tests would reach speeds faster than the speed of sound (in excess of Mach 1) and land at Edwards Air Force Base (AFB), California.

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2.0 DESCRIPTION OF THE PROPOSED ACTION

Alternative A, the Proposed Action, is to conduct test and operational flights by high-speed vehicles that operate at altitudes above 30,000 feet MSL up to the edge of space; and travel over the eastern Pacific Ocean and the western United States from the Pacific Ocean to the eastern borders of Texas, Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota; and land at Edwards AFB. These vehicles could be launched from any DOD or NASA installation or from any spaceport, or they could be air-launched from a carrier aircraft. Under Alternative B, high-speed vehicle flights would only occur over the Pacific Ocean except for the launch and landing phase of the flight. Under Alternative C, flights would occur over the western United States, from west of the Rocky Mountains to the Pacific Coast and from the Canadian border to Mexico. Flight tests under Alternative D would only occur over portions of the western United States including California, Nevada, Utah, Arizona, New Mexico, Colorado, Wyoming, Texas, Oklahoma, Kansas, Nebraska, and South Dakota. Alternative E would be a computer simulation of the flight trajectories over the entire region. Alternative F (No-Action Alternative) is the status quo where high speed testing is done on an ad hoc basis mostly over the eastern Pacific Ocean.

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3.1 NOISE

The noise impact for this proposed project would result from the sonic boom created by the flight vehicle as it accelerated up to Mach 7.0 (based on analyzed trajectories) and cruised toward or away from Edwards AFB. The sonic boom would be heard for less than 1 second over any location along the flight path with an intensity of 0.2–0.6 pounds per square foot (psf). A sonic boom with an intensity of 0.6–2.0 psf would also be heard over approximately 12 percent of the trajectory being used. Four areas on the ground near the launch point, totaling less than 0.0000021 percent of the region of influence (2,500 of 1,179,502,720 acres [number of acres for the states listed in Alternative A]) would experience a sonic boom with intensity of 2.0–3.1 psf (Figure 3-3). The chances are small that noise from the sonic boom would be heard by many people on the ground because the flight path would occur over sparsely populated areas to the maximum extent possible and future flight paths would be required to avoid sensitive areas.

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1 Dec 08
Date

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1.0 NEED FOR THE PROPOSAL

The mission of the Air Force Flight Test Center (AFFTC) is to assist the Air Force defense of the United States and to protect its interest through aerospace power. To fulfill its mission, the AFFTC ensures current and future airmen have proven equipment when flying into harm's way and that warriors operate battle-ready weapon systems. The AFFTC's contribution to the U.S. fighting forces results from test and evaluation—the bedrock of Edwards's existence. Consequently, the AFFTC, in cooperation with National Aeronautic and Space Administration Dryden Flight Research Center (NASA DFRC), needs to flight test vehicles at very high altitudes (up to 264,000 feet above mean sea level [MSL]) and speeds faster than the speed of sound (in excess of Mach 1) so they are proven battle-ready equipment. Conducting these tests will support the development of future, low cost, high speed aircraft and advanced, second-generation space transportation vehicles.

The high speed flight vehicles need to be tested in a realistic operational launch, cruise, and landing environment without compromising public safety, unduly interfering with commercial and private aircraft, or adversely affecting the environment. Up to 48 flight plans per year would be expected through 2015, although it should be understood that the probability of this many flights occurring in any one year is very small.

The types of aircraft studied in developing this EA are one-of-a kind research aircraft that will be developing new capabilities to fly efficiently at high speed within the atmosphere using supersonic combustion ramjet engines (Scramjet). Flight types include both ground takeoff and air launch from a carrier aircraft. In either case, the landing would occur at Edwards AFB. Even though flight trajectories for the above type aircraft were used to perform this assessment many other flight trajectories to higher altitudes could utilize the same flight area with even less impact to the environment.

Identifying the issues and completing the programmatic environmental document based on a generic vehicle configuration will reduce the time required for environmental process approval for a specific high speed vehicle configuration, leading to a first high-speed flight test in 2011. Other civilian or commercial programs may have additional requirements beyond those imposed by the Air Force and NASA DFRC. It would be the responsibility of the civilian or commercial program office to identify and meet additional NEPA requirements, including all other applicable laws and regulations, prior to conducting any flight test.

While this environmental assessment (EA) primarily analyzes the impacts associated with launch of a high speed vehicle from Edwards Air Force Base (AFB), high altitude cruise, and recovery at Edwards

AFB, other launch sites could be used; however, the environmental documentation to support a launch from another facility would be the responsibility of that launch site.

The decision to be made is whether or not the U.S. Air Force could conduct high speed flight tests over the western United States and eastern Pacific Ocean from above 30,000 feet MSL to the edge of space.

1.1 EXISTING AND PROPOSED FUTURE CONDITIONS

1.1.1 Existing Conditions

Flight vehicles routinely launch from Edwards AFB and operate in the R-2508 Complex and National Airspace System (NAS). Military flight plans authorizing high speed flight above Mach 1 do occur in designated special use airspace. These flights occur at altitudes above 30,000 feet MSL over the continental United States—and over the ocean above 10,000 feet and at least 15 miles from shore—and are conducted according to Federal Aviation Administration (FAA) and Headquarters United States Air Force, Washington, D.C. guidelines (Air Force Instruction [AFI] 13-201 2006). Civilian supersonic flight over the continental United States requires a specific authorization by the Administrator of the FAA and other requirements as listed in Appendix B to Title 14, Code of Federal Regulations (CFR), Part 91 Section 91.817. Air quality regulations under the Clean Air Act (CAA) establish *de minimis* levels for emissions below 3,000 feet; consequently, emissions occurring in the stratosphere and mesosphere where these flight tests would occur would not be governed by the CAA. There are no animals or plants in the region of influence; and only a limited number of birds that may be around the launch and landing site for these high speed test vehicles.

1.1.2 Proposed Future Conditions

The AFFTC, in cooperation with NASA DFRC, would propose that Department of Defense (DOD) (military) and NASA sponsored vehicles continue to launch and operate in and out of Edwards AFB on flight plans authorizing high speed flight above Mach 1 in accordance with approved flight plans and all FAA and DOD regulations (Flight Information Publication Area Planning (FLIP AP)/1B and AFI 13-201) at altitudes above 30,000 feet MSL over the continental United States, and over the ocean above 10,000 feet and 15 miles from shore. Low speed flights below Mach 1 would continue to occur as authorized on approved flight plans. Flight plans would include a safety analysis, comply with all applicable laws and regulations, and would avoid populated areas and other sensitive areas to the maximum extent possible. Additionally, flight plans for high speed flights (Mach 3.5+) above 30,000 feet MSL up to the edge of space over the western United States would be developed to ensure the associated sonic booms would not result in a significant percentage of the population being highly annoyed or the potential for impacts on

structures, wildlife, or air quality to be significant. Typically, the majority of each planned flight would occur above 60,000 feet MSL, above FAA controlled airspace, and above the highest altitude used by subsonic commercial/private aircraft (approximately 50,000 feet MSL).

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2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

This chapter describes the Proposed Action and Alternatives, including the No-Action Alternative. For Alternatives A, B, C, and D, the vehicle would:

- Climb to 30,000 feet MSL before accelerating to speeds above Mach 1;
- Operate at speeds above Mach 3.5 above 50,000 feet MSL;
- Operate within the R-2508 Complex to the maximum extent possible; and
- Operate on an approved flight plan coordinated with the FAA for all high speed flights above Mach 1 occurring outside the R-2508 Complex.

Computer simulation is a standard of the flight industry that helps reduce the number of flight tests and associated emissions and sonic booms for the Proposed Action and Alternatives. Consequently, computer modeling would be used as part of Alternatives A, B, C, and D that are described below.

2.2 DESCRIPTION OF THE ALTERNATIVES

Alternative A, the Proposed Action, is to conduct test and operational flights by high-speed vehicles that operate at altitudes above 30,000 feet MSL up to the edge of space; and travel over the eastern Pacific Ocean and the western United States from the Pacific Ocean to the eastern borders of Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota and from the Canadian border to the border of Mexico; and land at Edwards AFB, California. These vehicles could be launched from any DOD or NASA installation or from any spaceport, or they could be air-launched from a carrier aircraft. Under Alternative B, high-speed vehicle flights would only occur over the Pacific Ocean except for the launch and landing phase of the flight. Under Alternative C, flights would occur over the western United States, from west of the Rocky Mountains to the Pacific Coast and from the Canadian border to the border of Mexico. Flight tests under Alternative D would only occur over portions of the western United States including California, Nevada, Utah, Arizona, New Mexico, Colorado, Wyoming, Texas, Oklahoma, Kansas, Nebraska, and South Dakota. Under Alternative E, a computer simulation of the flight trajectories would occur over the entire region. Alternative F (No-Action Alternative) is the status quo

where high speed testing is done on an ad hoc basis mostly over the eastern Pacific Ocean. Figure 2-1 shows the operations area for Alternatives A through E; except for flight plans conducted in the R-2508 Complex, flights would occur above 60,000 feet MSL.

2.3 ISSUES AND CONCERNS

During the scoping process, the following issues and concerns were identified as requiring assessment when considering the potential environmental impacts of the alternatives.

- Air Quality. Air pollutant emissions are generated from carrier and chase aircraft, flight vehicles, and aerospace ground equipment (AGE). Potential impacts on air quality at Edwards AFB and emissions occurring in the upper troposphere and stratosphere were analyzed.

Figure 2-1 Operations Area in the Western United States

- Noise/Sonic Booms. Noise from these flight tests may be heard on the ground along the intended flight trajectory. Potential impacts of flight activities will be assessed.

- Airspace Management and Air Safety. Use of the NAS airspace was analyzed for potential impacts on other vehicles (manned or unmanned) and other programs.

2.4 ISSUES AND CONCERNS CONSIDERED BUT ELIMINATED FROM FURTHER STUDY

The following issues and concerns were initially considered, but subsequently eliminated from further analysis in this EA. Consequently, they will only be briefly addressed below.

- Cultural Resources. Cultural resources could be impacted during flight tests if the noise or sonic booms damaged structures or sites. Flight trajectories would be at extremely high altitudes and would avoid sensitive and avoidance locations published in Chapter 5 of FLIP AP/1B. Consequently, these test flights would not result in impacts to cultural resources that have yielded, or are likely to yield, information important in prehistory or history; would not result in physical destruction or alteration or all or part of the property or areas that are National Historic Landmarks; and would not result in a substantial decrease in access to traditional Native American resources.

- Environmental Justice and Protection of Children. The Executive Orders (EOs) on Environmental Justice and the protection of children require federal agencies to identify and address disproportionately high adverse effects of their activities on minority and low-income populations and children. The proposed activities discussed in this EA were reviewed against EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, and EO 13045, *Protection of Children from Environmental Health and Safety Risks*. Given that all activities would occur entirely on the Base and flight operations would be conducted on preexisting ranges, the U.S. Air Force has determined that this action would have no substantial, disproportionate impacts on minority and low-income populations and/or children.

- Geology and Soils. Flight by aircraft and other flight vehicles is a normal occurrence, and there is no direct contact or ground disturbance between these flight vehicles and the geology and soils. The Proposed Action or Alternatives would not result in the disruption of the upper dried clayey surface crust of dry lakebeds or playas; would not result in the loss irrevocable loss of established or potential mineral-bearing resources of economic value; and would not result in vegetation removal, grading, or other soil

disturbance that would cause substantial accelerated water erosion. Consequently, no impacts would be expected to occur.

- Hazardous Materials/Hazardous Waste/Solid Waste. The flight vehicles would use hazardous materials that would generate hazardous waste similar to other aircraft flight activities at Edwards AFB, other DOD and NASA facilities, and spaceports. The amount of hazardous materials used and waste generated for up to 48 flights each year would be less than significant when added to the approximately 10,500+ flights that occur annually (less than a 0.005 percent increase) at Edwards AFB. Consequently, there would be no significant impacts because the quantity would be extremely low—similar to other hazardous materials used and waste generated—and regulations for hazardous materials/waste management are in place and adhered to, thus preventing impacts from occurring.

- Infrastructure. Flight vehicles would be expected to use existing facilities and hangars to the maximum extent possible. The temporary use of mobile radar and other intelligence gathering devices (monitoring equipment) would be used to ensure important data could be collected in areas not supported by the current infrastructure. Once a specific flight trajectory was identified, the Air Force and/or NASA DFRC would coordinate with the site owners to determine if use of the proposed monitoring sites would require additional environmental documentation. If required, the environmental documentation would be completed prior to siting any monitoring equipment on previously undisturbed areas. Consequently, the Proposed Action or Alternatives would not increase demand over capacity; would not increase the volume of traffic beyond existing road capacity; and would not encourage activities which result in the use of large amounts of fuel, water, or energy. Monitoring equipment located on previously disturbed areas within the operations area would not be expected to create any additional impacts.

- Land Use. The frequency and duration of the noise created by these flight trajectories would not interfere with how the land is used because the 48 or less trajectories that would occur annually would avoid sensitive areas to the maximum extent possible. The Proposed Action and Alternatives would not have a substantial demonstrable negative aesthetic effect on or disrupt a designated scenic corridor, would not result in substantial new development or prevent such development elsewhere, and would not result in direct

evidence of human activity that would reduce recreationalist perceived levels of isolation and solitude. Consequently, significant impacts on land use would not be expected.

- Natural Resources. The Proposed Action or Alternatives would not result in the removal, filling, or substantial disturbance of a natural community; would not result in a wildlife population dropping below self-sustaining levels; would not cause the measurable degradation of sensitive habitats; would not cause direct impacts or disturbance on marine mammals protected by state or federal codes; and would not reduce or increase the viability of any plant or animal population or the ability of the population to persist through time because the flights would be operating at extremely high altitudes. Potential impacts on wildlife from noise and sonic booms from flights faster than the speed of sound were analyzed in the noise section. Studies indicate that wildlife typically habituate to infrequent noise without long-term effects. A list of studies is provided in Appendix B.3.

- Public/Emergency Services. The DOD has developed specific emergency plans that would be activated in case of any emergency involving aircraft or other flight vehicles. Provisions for public/emergency services are established for the base and communities within the R-2508 Complex and other ranges to meet the needs of the mission. Therefore, this action would have no impact on public or emergency services.

- Safety and Occupational Health. Maintenance and flightline personnel would use the same hazardous substances and be exposed to the same types of hazards while performing maintenance activities as with other aircraft. The Proposed Action or Alternatives would not increase safety hazards beyond existing levels, would not be inconsistent with existing health and safety regulations, and would not create or exacerbate an existing fire hazard. Regulations are in place to prevent impacts on safety and occupational health from these activities that would occur on Edwards AFB; consequently, no impacts would be expected.

- Socioeconomics. The level of support personnel during the program activities would remain constant with the current level of flight test employees. Employees of programs being completed are expected to move to new programs as they begin. Only minor changes in the number of base employees are expected. The Proposed Action or Alternatives would not induce substantial growth or result in concentration of people by

10 percent or more above the historic baseline, would not cause a demand for new schools or other major public services, and would not cause a demand for housing that could not be accommodated by construction activities. Therefore, no impacts to the economy on the base and in the surrounding communities would be expected.

- Water Resources. No potential impacts on water resources have been identified. Edwards AFB has standard measures in place to protect water resources during routine fueling and maintenance activities. The Proposed Action or Alternatives would not result in substantial reduction in the quantity or quality of water resources for existing or potential future uses, would not result in a substantial loss or degradation of natural communities' wetland resources, and would not cause an unacceptable flow condition which could potentially cause an increase in erosion or excessive sedimentation. Because the Proposed Action would be similar to other routine flight activities that result in little or no impact and would occur at extremely high altitudes, no impacts would be expected.

2.5 OTHER FUTURE ACTIONS IN THE REGION

Other actions within the region were evaluated to determine whether cumulative environmental impacts could result from implementation of the Proposed Action or Alternatives. Cumulative impacts result from "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

Other actions within the geographic region of Edwards AFB and the R-2508/R-2515 special use airspace that could be considered to have the potential for cumulative effects include other flight test programs conducted by NASA, private activities like Space Ship One, and launches from the Mojave Spaceport. A discussion of potential cumulative impacts associated with other actions is included in Chapter 4; however, it should be noted that few other actions occur above 30,000 feet MSL.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes existing environmental conditions and environmental consequences likely to occur within the region of influence (ROI). The ROI consists of Edwards AFB, the R-2508 Complex, and the airspace above 60,000 feet MSL, as shown in Figure 2-1. Resources within the ROI that could potentially be affected include air quality, noise, and airspace management/air safety. These effected resources in addition to hazardous waste/solid waste, natural resources, infrastructure, safety and occupational health, environmental justice, and socioeconomics were evaluated. No significant impacts were identified during the impact assessment.

Table 3-1 shows the anticipated environmental effects for all the resource areas. Because this project would be similar to other flight operations and assessments whose affected environment and environmental consequences have previously been analyzed, the following projects are incorporated by reference and included in the administrative record. Three Environmental Assessments incorporated by reference are summarized in the following paragraphs.

Routine and Recurring Small Transient and New Missions Environmental Assessment, 95th Air Base Wing, Edwards AFB April 2008

The Air Force Flight Test Center at Edwards AFB, California, proposes to add up to 25 aircraft, 2,000 sorties per year, and 1,500 military, government civilian, and contractor personnel to support small transient and new test missions that would operate at Edwards AFB and in the R-2508 Complex. This Environmental Assessment evaluates the potential effects of the proposed project, including major and minor construction that could be needed to support the Proposed Action or Alternatives. Alternative A would include the complete contingent of aircraft, personnel, and major construction activities. The proposed action would result in a 20 percent increase over current operations at Edwards AFB and a 5.9 percent increase in use of the R-2508 Complex. These increased levels of activity would be significantly below activity that occurred in the 1980s and 1990s. Major construction would occur over a 3-year period, with the majority of the construction occurring during the first 2 years of the Proposed Action. Alternative B would be similar to Alternative A, except only minor construction would occur; Alternative C would use existing facilities; and Alternative D is the No-Action Alternative. Air emissions would be below *de minimis* values for Kern County pollutants of concern, and noise levels would add to the current noise but would still be below the annoyance threshold for sonic booms.

Table 3-1

Anticipated Environmental Effects

Resource Area	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Air Quality	• 13.41 tons VOCs • 8.73 tons NO_2 • 16.37 tons CO • 0.41 ton SO_2 • 1.58 tons PM_{10} • 2,379.86 metric tons CO_2eq	• 13.41 tons VOCs • 8.73 tons NO_2 • 16.37 tons CO • 0.41 ton SO_2 • 1.58 tons PM_{10} • 2,379.86 metric tons CO_2eq	• 13.41 tons VOCs • 8.73 tons NO_2 • 16.37 tons CO • 0.41 ton SO_2 • 1.58 tons PM_{10} • 2,379.86 metric tons CO_2eq	• 13.41 tons VOCs • 8.73 tons NO_2 • 16.37 tons CO • 0.41 ton SO_2 • 1.58 tons PM_{10} • 2,379.86 metric tons CO_2eq	No emissions	• 4,185 tons VOCs • 1,312 tons NO_2 • 1,042 tons PM_{10}
Airspace Management and Air Safety	48 flights/year; 95% above controlled NAS	48 flights/year; 95% above controlled NAS	48 flights/year; 95% above controlled NAS	48 flights/year; 95% above controlled NAS	No commercial flights effected	10,500+ flight per year
Cultural	None	None	None	None	None	None
Environmental Justice and the Protection of Children	None	None	None	None	None	None
Geology and Soils	None	None	None	None	None	None
Hazardous Substances	None	None	None	None	None	None
Infrastructure	None	None	None	None	None	None
Land Use	None	None	None	None	None	None
Natural Resources	None	None	None	None	None	None
• **Desert Tortoise**	None	None	None	None	None	None
• **Mohave Ground Squirrel**	None	None	None	None	None	None

Table 3-1, Page 1 of 2

Table 3-1

Anticipated Environmental Effects (Continued)

Resource Area	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Noise/Sonic Booms	48 sonic booms/year at 0.2 to 3.1 psf	48 sonic booms/year at 0.2 to 3.1 psf	48 sonic booms/year at 0.2 to 3.1 psf	48 sonic booms/year at 0.2 to 3.1 psf	No noise or sonic booms	An average of 616 supersonic flights annually averaging 1.3 psf
Public/Emergency Services	None	None	None	None	None	None
Safety/Occupational Health	None	None	None	None	None	None
Socioeconomics	None	None	None	None	None	None
Water Resources	None	None	None	None	None	None

Table 3-1, Page 2 of 2

Notes:

CO carbon monoxide
CO_2eq carbon dioxide equivalent
NAS National Airspace System
NO_2 nitrogen dioxide
PM_{10} particulate matter equal to or less than 10 microns in diameter
psf pounds per square foot
SO_2 sulfur dioxide
VOC volatile organic compound

Environmental Assessment for Routine and Recurring Unmanned Aerial Vehicle Flight Operations at Edwards AFB, California, 95th Air Base Wing, November 2006

The purpose of the Proposed Action is to continue the routine and recurring mission of the AFFTC as the center of flight and flight systems test and evaluation for the Air Force by evolving the capability to test unmanned aerial vehicles (UAVs) and their associated aeronautical systems in the same manner as manned aircraft. This EA evaluated the potential environmental impacts associated with the flight operations for test and evaluation of UAVs by the AFFTC within the R-2508 Complex of special use airspace and Edwards AFB, with flights to the Naval Air Weapons Center (NAWC) Point Mugu Sea Range (Sea Range), and Nellis Test and Training Range (NTTR) via transitional corridors. The Proposed Action would conduct up to 152 flight tests (including chase aircraft) in 2006 increasing to up to 528 flight tests (including chase aircraft) in 2011for all classes of UAVs within the R-2508 Complex. Alternative B would limit the tests to Edwards AFB and the R-2515 special use airspace, Alternative C would limit the tests to the airspace above Edwards AFB, and Alternative D, the No-Action Alternative, would allow for the continued operation of current programs like the Global Hawk and Predator UAVs. Based on the findings of the EA, no significant impact to the human environment would be expected from implementation of the Proposed Action or Alternatives. No mitigation measures were recommended. Therefore, issuance of a Finding of No Significant Impact (FONSI) was warranted, and preparation of an Environmental Impact Statement, pursuant to the National Environmental Policy Act (NEPA; Public Law 91-190) was not required.

Environmental Assessment for the Orbital Reentry Corridor for Generic Unmanned Lifting Entry Vehicles Landing at Edwards Air Force Base, California, 95th Air Base Wing, December 2002

This EA evaluated the potential environmental impacts associated with the proposed establishment of an orbital reentry corridor into Edwards AFB for generic, medium size, unmanned lifting entry vehicles (LEVs) returning from low earth orbit to final approach and landing at Edwards AFB. An unmanned LEV capable of landing on a normal aircraft runway is seen as a key to increasing access to space at a reasonable cost. Several research programs are devoted to developing unmanned LEVs that would provide reliable and reusable means of transporting small payloads from earth orbit. This EA only addressed the reentry and landing phases of the intended test vehicle program. Analysis of other phases (e.g., vehicle fabrication, launch, and refurbishment) will be the responsibility of the intended test vehicle program office; separate environmental documentation would be required under these phases of the program. Two corridors were identified, a Western Orbital Reentry Corridor approximately 140 nautical miles wide crossing the California coast and a Northwestern Orbital Reentry Corridor that would be

approximately 240 nautical miles wide as it crossed the California/Oregon coast. The unmanned LEV would cross the coastline at an elevation of approximately 108,000 feet above mean sea level for the first corridor and approximately 160,000 feet above mean sea level for the second corridor.

Resources within the ROI were identified and evaluated under the following categories: air quality, airspace, cultural resources, environmental justice, geology and soils, hazardous waste/hazardous materials, infrastructure, land use, natural resources, noise, public/emergency services, safety, socioeconomics, and water resources.

In general, potential impacts associated with the proposed project were considered under one of two categories: (1) impacts associated with potential landing failure of the unmanned LEV and a crash or (2) impacts associated with normal operation of the reentry and landing phases of the Orbital Reentry Corridor Program. The unmanned LEV was assumed to weigh 25,000 pounds during reentry and to be 30 feet long and 15.5 feet wide. For the purposes of this document, it was assumed that if the unmanned LEV were to crash, it could either crash intact or break into its seven components (two vertical fins, two rudders, two body flaps, and the core body). Normal operation of the reentry and landing phases of the Orbital Reentry Corridor Program included vertical and horizontal maneuvering of the unmanned LEV through uncontrolled and controlled airspace and avoidance of other air traffic during reentry and landing of the vehicle on Runway 22 or on Rogers Dry Lakebed at Edwards AFB.

On the basis of the findings of the Environmental Assessment, no significant impact to human health or the natural environment would be expected from implementation of the Proposed Action. No mitigation measures were recommended. Therefore, issuance of a FONSI was warranted, and preparation of an Environmental Impact Statement was not required.

3.1 AIR QUALITY

The Proposed Action and Alternatives would only affect ambient air quality in the area of Edwards AFB and at the takeoff and landing location. This EA focuses on takeoff and landing at Edwards AFB; consequently, analysis for air emissions for takeoff or landing at other locations would be the responsibility of that specific location. Air emissions would be generated along the entire length of a trajectory as it is used; however air emissions generated below 3,000 feet above ground level (AGL) would only occur over Edwards AFB. Consequently, the discussion of the affected environment and environmental consequences for air quality is limited to the region surrounding Edwards AFB and the

troposphere and stratosphere for the portions of the flight trajectory occurring in those parts of the atmosphere.

3.1.1 Affected Environment—Air Quality

3.1.1.1 Affected Environment for Takeoff and Landing at Edwards AFB

The altitude of 3,000 feet above the surface of the ground is appropriate for evaluating air quality impacts because the federal government (U.S. Environmental Protection Agency [U.S. EPA]) uses that altitude to assess contributions of emissions to the ambient air quality and for the threshold calculations under the Clean Air Act (CAA). The affected environment for air quality for takeoff and landing at Edwards AFB would be the same for any trajectory flown. Background data and a discussion of the pollutants regulated under the CAA, ambient air quality standards for criteria pollutants, and air toxics can be found in Appendix A.

Conformity Requirements

Federal facilities located in a National Ambient Air Quality Standards (NAAQS) nonattainment area are required to comply with federal air conformity rules and regulations of 40 CFR Part 93, Section 93.153 and 40 CFR Part 51, Section 51.853. Under air conformity, a facility (such as Edwards AFB) that initiates a new action (such as the proposed project) must quantify air emissions from stationary and mobile sources associated with that action. The calculated emissions are compared to established *de minimis* emission levels (based on the nonattainment status for each applicable criteria pollutant in the ROI) to determine the relevant compliance requirements. Table 3-2 defines the *de minimis* thresholds that apply to eastern Kern County, where Edwards AFB is located. If the calculated emissions are equal to or greater than *de minimis* levels, then the requirements of air conformity apply to the action.

In addition to comparing emissions against *de minimis* levels, federal actions must not be considered regionally significant, which is defined as any action in which direct and indirect emissions of any pollutant represent 10 percent or more of a non-attainment or maintenance area’s emissions inventory for that pollutant. Table 3-3 shows the baseline and forecast emissions inventory level and threshold that would exceed the significance threshold for the eastern Kern County portion of the Mojave Desert Air Basin (MDAB) where takeoff and landing of the test vehicles would occur.

Table 3-2

***De Minimis* Thresholds in Nonattainment Areas and Eastern Kern County**

Pollutant	Degree of Non-Attainment	*De Minimis* Level (tons/year)	Kern County
Ozone	Serious	50	
	Severe	25	
	Extreme	10	
	Marginal and Moderate (outside an ozone transport region)	100	
	Marginal and Moderate (inside an ozone transport region)	100 (VOC)	X
		100 (NO_x)	X
Carbon monoxide	All	100	
Particulate matter	Moderate	100	
	Serious	70	
SO_2 or NO_2	All	100	
Lead	All	25	

Notes: NO_2 nitrogen dioxide
NO nitrogen oxides
SO_2 sulfur dioxide
VOC volatile organic compound

Table 3-3

Eastern Kern County (KAPCD) Emission

Baseline and Forecasted Emission Baseline (tons/year) and 10 Percent Values

Year	VOC (ROG)	10 Percent	NO_x	10 Percent
1990[(a)]	10184	1,018	17,100	1,710
1995[(a)]	6,263	626	12,939	1,294
2000[(a)]	5,125	513	13,206	1,321
2005[(a)]	4,749	475	13,275	1,328
2010[((b)]	4,387	439	12,928	1,293
2015[(b)]	4,592	459	13,319	1,332
2020[(b)]	4,555	456	13,319	1,332

Notes: a actual
b estimated
NO_x nitrogen oxides
ROG reactive organic gases
VOC volatile organic compound

Source: Ward 2008, Kern County Air Pollution Control District 2003

3.1.1.2 Affected Environment for Flights Above 3,000 Feet AGL for the Region of Influence

Atmospheric Conditions

Although air is well mixed throughout the atmosphere, the atmosphere itself is not physically uniform. It has significant variations in temperature and pressure with altitude, and these define a number of atmospheric layers. These include the troposphere (0 to 18 kilometers [10 miles] above MSL), stratosphere (18 to 50 kilometers [31 miles] above MSL), mesosphere (50 to 80 kilometers [50 miles] above MSL), thermosphere (80 to 690 kilometers [428 miles] above MSL), and exosphere (690 to 800 kilometers [497 miles] above MSL) (Figure 3-1).

The boundaries between these four layers are defined by abrupt changes in temperature. The troposphere is the layer where most of the world's weather takes place. Since temperature decreases with altitude in the troposphere, warm air near the surface of the Earth can readily rise, as it is less dense than the colder air above it. In fact, air molecules can travel to the top of the troposphere and back down again in a just a few days. Such vertical movement or convection of air generates clouds, and ultimately rain, from the moisture within the air and gives rise to much of the weather which we experience. The troposphere is capped by the tropopause, a region of stable temperature. Air temperature then begins to rise in the stratosphere. This temperature increase prevents much air convection beyond the tropopause, and consequently most weather phenomena, including towering cumulonimbus thunderclouds, are confined to the troposphere.

The stratosphere is the second major layer of the atmosphere. It lies above the troposphere and is separated from it by the tropopause. Its lower boundary tends to be higher nearer the equator and lower nearer the poles.

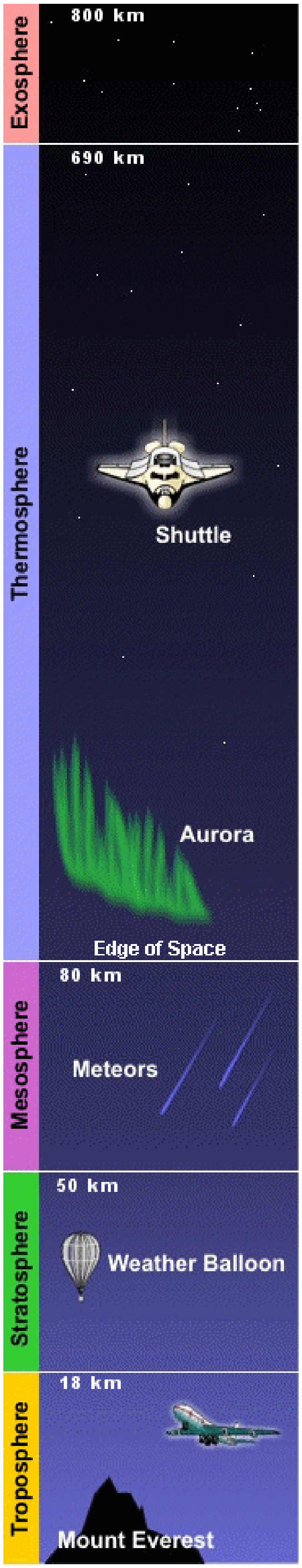


Figure 3-1 Earth's Atmosphere to the Edge of Space

Note: The flight trajectory would extend from 30,000 to 264,000 feet (9 to 80 km) above the earth. At that altitude it would be difficult to see the vehicle.
Source: (National Oceanic and Atmospheric Administration 2008)

The stratosphere defines a layer in which temperatures rise with increasing altitude. From the bottom to the top of the stratosphere, the temperature of the thin air may change from temperatures near 100 degrees Fahrenheit to temperatures close to 32 degree Fahrenheit.

This change in temperature is caused by the absorption of ultraviolet radiation from the sun by the ozone layer. Such a temperature profile creates very stable atmospheric conditions, and the stratosphere lacks the air turbulence that is so prevalent in the troposphere. Consequently, the stratosphere is almost completely free of clouds or other forms of weather. The stratosphere provides some advantages for long-distance flight because it is above stormy weather and has strong, steady, horizontal winds.

The mesosphere (literally middle sphere) is the third highest layer in our atmosphere, occupying the region from 164,042 feet to 264,000 feet (50 km to 80 km) above the surface of the Earth, above the troposphere and stratosphere, and below the thermosphere. It is separated from the stratosphere by the stratopause and from the thermosphere by the mesopause.

Temperatures in the mesosphere drop with increasing altitude to about minus 100 degree Centigrade. The mesosphere is the coldest of the atmospheric layers. In fact it is colder then Antarctica's lowest recorded temperature. It is cold enough to freeze water vapor into ice clouds. You can see these clouds if sunlight hits them after sunset. They are called noctilucent clouds (NLC). NLCs are most readily visible when the Sun is from 4 to 16 degrees below the horizon. Researchers speculate that the origin and spread of the NLCs is linked to patterns of climate change associated with the modern era, but they are not ruling out a host of other possible factors, including methane, carbon dioxide, the number of meteors seeding the upper atmosphere, and even the 11-year sunspot cycle (Hsu 2007).

3.1.2 Environmental Consequences on Air Quality

3.1.2.1 Environmental Consequences for Takeoff and Landing at Edwards AFB

The primary effects on air quality for takeoff and landing at Edwards AFB would be the same for any trajectory beginning and ending at Edwards AFB. Flight vehicles released from a carrier aircraft would not generate emissions below 3,000 feet AGL because the engines would not be turned on until the vehicle was released from the carrier aircraft above 30,000 feet MSL and because the engines would be shut down before the vehicle descended below 30,000 feet MSL on returning to Edwards AFB for landing. Emissions would be generated below 3,000 feet AGL for flight vehicles taking off horizontally or under their own power from the runway; however, the emissions would be expected to be similar to or less than emissions from the carrier aircraft as shown in Appendix A.1. If the flight vehicle made a powered landing, then emissions would be expected to be similar to or less than emissions of the carrier

aircraft. The predicted emissions from the support equipment, including the carrier aircraft, are shown in Table 3-4. The projections indicate the ozone precursor emissions (nitrogen dioxide [NO_2] and volatile organic compounds [VOCs]) would be approximately 22 tons per year. In all cases, the emission levels for each pollutant would be well below *de minimis* levels established by regulation, ranging from approximately 9 to 14 percent of the *de minimis* threshold levels for volatile organic compounds and nitrogen dioxide. There are no unusual air toxics associated with these test vehicles; chemicals associated with these vehicles are managed according to standard operating procedures.

Table 3-4

Projected Annual Program Emissions Below 3,000 feet AGL

	Emissions (tons/year)				
	VOCs (ROGs)	**NO_2**	**CO**	**SO_2**	**PM_{10}**
Proposed Action	13.41	8.73	16.37	0.41	1.58
Regulatory Limits	100	100	N/A	N/A	N/A
Percent of *de minimis*	13.41	8.73	N/A	N/A	N/A

Notes: Calculations are shown in Appendix A.1.

CO carbon monoxide
N/A not applicable
NO_2 nitrogen dioxide
PM_{10} particulate matter equal to or less than 10 microns in diameter
ROG reactive organic gases
VOC volatile organic compound

The predicted air emissions that would occur in the MDAB portion of Kern County, where standards are more stringent than in the Antelope Valley Air Quality Management District (AVAQMD), would still be below *de minimis* standards. In addition, the emissions of ozone precursors would be less than 0.01 percent of the total Kern County and AVAQMD inventories. Because these emission levels would be below *de minimis* thresholds, it could be assumed that air quality impacts below 3,000 feet AGL would be less than significant if the Proposed Action was implemented.

3.1.2.2 Environmental Consequences for Flights Above 3,000 Feet AGL for the Region of Influence

Greenhouse Gas Emissions

Greenhouse gases (GHG) include water vapor, carbon dioxide (CO_2), methane, nitrous oxides, ozone, and chlorofluorocarbons. Water vapor is a naturally occurring GHG and accounts for the largest percentage of greenhouse effect. Next to water vapor, CO_2 is the most abundant GHG (Department of Energy [DOE] 2007). Because CO_2 is relatively stable in the atmosphere and uniformly mixed throughout the troposphere and stratosphere, the climatic impact of CO_2 emissions does not depend on the CO_2 source

location on earth. Although regulatory agencies are taking action to address GHG effects, there are currently no federal standards or regulations limiting CO_2 emissions and concentrations in ambient air. Every GHG has a Global Warming Potential (GWP), a measurement of the impact that particular gas has on 'radiative forcing'; that is, the additional heat/energy which is retained in the Earth's ecosystem through the addition of this gas to the atmosphere. The total carbon dioxide equivalent (CO_2eq)(used to help quantify the GWP) for this project would be approximately 2,379.86 metric tons per year. The U.S. EPA estimates that in 2012 the total carbon dioxide equivalent for fossil fuel use in the U.S. will be between 6,060,000,000 metric tons and 6,318,000,000 metric tons; therefore the contribution from this program would be less than 0.00000039272 percent of the U.S. total. Considering that the California Air Resources Board uses 2,500 metric tons of CO_2 as the threshold for reporting under the Regulation for the *Mandatory Reporting of Greenhouse Gas Emissions* for electricity generation and cogeneration facilities and the emissions for this Proposed Action would be below that threshold value, one could assume that these emissions would be considered less than significant. Although the impact of greenhouse gases resulting from the Proposed Action would be less than significant when compared to the mega-million tons of emissions created by commercial aviation, it is still an issue of global concern.

In 2006 the California legislature passed Assembly Bill 32, *California Global Warming Solutions Act of 2006*, which requires the CARB to adopt regulations and to report and verify statewide GHG emissions. While this Act has no jurisdiction at Edwards AFB, the base will follow the Act's basic tenets which are similar to requirements established by the Kyoto Protocol.

The aviation sector currently is the source of about 2.6 percent of the greenhouse gas emissions in the United States, with the United States military contributing only a small portion. Military aviation used approximately 0.5 percent of the United States aviation fuel in 2000. Non-aviation transportation emits 25 percent, industrial operations emit 41 percent, and other United States sources emit 31 percent of the greenhouse gases (U.S. EPA 2006).

The aviation sector is expecting substantial growth in the next 20 to 30 years. The resulting increases in aircraft emissions caused by a growing demand for air travel would not be fully offset by technical improvements alone (e. g., air frame design, engine efficiency, air traffic management). Technological and scientific research to reduce the impact of aviation on the global atmosphere is important since there is currently no economically feasible alternative to the kerosene-based jet fuel used by aircraft (U.S. Government Accountability Office [GAO] 2000). Unfortunately, funding for such research is minimal. Most research and funding are being concentrated on the energy and non-aviation transportation sectors, where the majority of emissions are being generated.

Improvements in aircraft engines (i.e., reductions in weight, application of new technologies) are expected to significantly improve fuel efficiency, but there are trade-offs between applying these new engine technologies and ensuring safety and performance (GAO 2000). Technological and operational improvements in emissions from military aircraft have been more challenging to achieve because of the mission/performance requirements for these vehicles (Waitz *et al.* 2004).

Emissions of nitrous oxide and methane from aviation are highly uncertain due to little knowledge of the magnitude of emission factors, but they do not contribute much to the national totals (Rypdal 2000). Emissions of water vapor are quickly removed in the troposphere by precipitation. However, in the lower stratosphere, water vapor emissions can build up and lead to higher concentrations that are predicted to warm the earth's surface. It is thought that water vapor may enhance the formation of contrails, the thin, white-line clouds often seen behind jet aircraft, which are also expected to warm the earth's surface. In addition, extensive cirrus clouds have been observed to develop after the formation of persistent contrails. These increases in cirrus cloud cover have been positively correlated with aircraft emissions in a limited number of studies (GAO 2000). The Air Transport Association of America, Inc. states that the mechanisms associated with increases in cirrus cloud cover are not well understood and need further investigation. According to NASA, which is studying the formation of contrail-induced cirrus clouds, the effect of clouds on the global climate is one of the biggest uncertainties in climate science today (GAO 2000).

3.1.3 Alternative A, Proposed Action

The emissions generated at Edwards AFB by Alternative A (Proposed Action) would be below *de minimis* thresholds and would only be a small percentage of the total emissions generated for all flight operations that occur at Edwards AFB. Consequently, it can be assumed that implementing the Proposed Action would not result in a significant increase in air emissions or impact on ambient air quality.

The true magnitude of environmental impact on greenhouse gases resulting from these test flights is unknown. The projected carbon dioxide produced by the vehicles driven by an additional 25 personnel is calculated at 115 metric tons annually. Table 3-5 lists the projected quantities of GHG that would be produced from 48 flight tests; calculations are shown in Appendix A.2. The total annual carbon dioxide for this program would be 1,211.15 metric tons (1,096.15 metric tons for flight related operations and 115 metric tons for vehicles) and CO_2 equivalents (CO_2eq) would equal 2,379.86 metric tons.

Table 3-5 Projected Annual Greenhouse Gas Global Warming Potential

Jet Fuel (JP-7)	Direct Product (Yes or No)	Quantity (metric tons)	Relative Global Warming Potential[4]	Carbon dioxide equivalent (metric tons)
Water vapor (steam)[1, 3]	Yes	450.32	0.73	328.74
Carbon dioxide[1]	Yes	1,096.15	1	1,096.15
Methane	No	-	21	-
Nitrous oxides	No	-	310	-
Ozone[2]	No	-	1.06	-
• Nitrogen oxides[1,3]	Yes[5]	792.44		839.98
Chlorofluorocarbons	No	-	140–23,900	-

Notes: 1 1.29 pounds of water is produced for each pound of JP-7 combusted; 3.14 pounds of carbon dioxide are produced for each pound of JP-7 combusted (Air Force Research Laboratory [AFRL] 2008) and 5 grams of nitrogen oxides for each kilogram of JP-7 combusted (NASA 1976).

2 Ozone might be produced as a secondary reaction at altitude, but is not a direct byproduct of combustion (AFRL 2008).

3 When NO_x emissions are coupled with water vapor, the ozone reduction caused by NO_x is decreased by a factor of 0.85 to 0.97 (depending on altitude and magnitude of the emissions (Airliners.net 2008).

4 The relative Global Warming Potentials (100 Year Time Horizon) are based on U.S. EPA guidelines (U.S.EPA 2006).

5 Nitrogen oxides are an indirect GWP that contributes to ozone production (Ramaswamy 2008).

However, in comparison to the overall contribution to greenhouse gases, the emissions from a relatively few number of flights would be very small when compared to the multi-million tons of emissions from commercials flights operating in the lower stratosphere. Consequently, although these flights would contribute to the overall total emissions of GHG, the addition of gases from these few flights would be less than significant. Mitigation measures to offset these greenhouse gases are discussed in Section 3.1.7.

3.1.4 Alternatives B, C, and D

The emissions that would be generated if Alternatives B, C, or D were implemented would have the same effect on ambient air quality at Edwards AFB as Alternative A because the takeoff and landing location would be the same and the number of flights would also be the same.

Greenhouse gas emissions if Alternatives B, C, or D were implemented would be the same as for Alternative A. The volume of emissions would not be dependent on the operating area because of the uniform dispersion of the emissions in the atmosphere. The concentrations would still be very small when compared to the multi-million tons of emissions created by the commercial flights operating in the lower stratosphere and upper troposphere. Consequently, although these flights would contribute to the overall total, the addition of gases from these few flights would be less than significant.

3.1.5 Alternative E

Because Alternative E would be a computer simulation, flight-related air emissions would not be created. Consequently, no impacts on air quality would be expected if Alternative E were implemented.

3.1.6 Alternative F, No-Action Alternative

Alternative F (No-Action Alternative) is the status quo. Air emissions would continue to be generated by other aircraft. Air emissions from mission and flight test aircraft operating from Edwards AFB would continue to occur as these aircraft comply with approved flight profiles per applicable DOD, Air Force, NASA, and AFFTC instructions.

3.1.7 Significance/Mitigation Measures

Currently the extent and nature of changes expected in the general areas of "global climate change" are subject to much debate and there are no clearly definitive answers. However, there is a general consensus that the region in and around Edwards AFB can expect slightly warmer temperatures and slightly less rainfall as a result of these changes. Impacts common to all alternatives, including the "no-action alternative," due to global climate change would be related to the expected slight temperature increase and slight precipitation decreases. Neither impact would be expected to limit or increase operations at Edwards AFB. The shifting climate issue may impact vegetation and wildlife (i.e., increased growing season, decrease in number of "hard freeze" nights, increased water stress of vegetation, and wildlife interaction issues).

When the projected emissions are compared to current emissions from flights at the base and to the emissions projected for the MDAB area for any year, they represent a very small percentage of total emissions. The significance levels for criteria pollutants are not exceeded and there are no significant concerns for air toxics within the Mojave Desert Air Quality Management District (MDAQMD) or AVAQMD that are not mitigated by training, procedures, and personal protective equipment. Based on the conformity applicability criteria, the proposed project emissions would be less than the 100 tons/year threshold for ozone precursors and less than the 10 percent threshold emissions for the Kern County Air Pollution Control District (KCAPCD). The proposed project would conform to the most recent U.S. EPA-approved State Implementation Plans, and no further detailed conformity applicability screening analysis is required. Because the projected emissions for all alternatives considered would be minimal, there would be no new or unique emissions or local issues. Since no other measurable impacts were

identified, no specific mitigation measures for air quality effects created by the Proposed Action or Alternatives B, C, and D would be required.

Edwards AFB is in the process of establishing a Carbon Neutral Program. The process by which carbon dioxide sinks remove CO_2 from the atmosphere is known as carbon sequestration. The Kyoto Protocol allows the use of carbon sinks as a form of carbon offset. The U.S. EPA publishes emission factors that can also be used to determine the amount of CO_2 offset for recycling and rideshare activities. Mitigation measures that are implemented at Edwards AFB to reduce the impacts of greenhouse gases include a rideshare program, which reduces direct emissions from cars and trucks, and a recycling program, which reduces energy consumption for producing metal, glass, plastics, and paper products. Under this program, offsets for recycling, ridesharing, and natural sequestration are equal to approximately 975,375 metric tons of carbon dioxide (see Appendix A.3). The emissions created during these few flight tests have been included in the calculations and show a net credit of 972,996 metric tons that can be used to offset other projects and programs. Additionally, EO 13423 requires each agency to reduce greenhouse gas emissions by 30 percent by 2010, based on emission levels in 1990. Consequently, the Proposed Action is in compliance with the base Carbon Neutral Program and on track to comply with EO 13423 and Kyoto Protocols.

3.2 NOISE

Background data on noise and sonic booms is provided in Appendix B.

3.2.1 Significant Noise Levels

The following noise levels are considered significant:

To protect the public in quiet outdoor areas, the U.S. EPA guidelines recommend a day-night average sound level (DNL or L_{dn}) of 55 A-weighted decibels (dBA) as the noise threshold (U.S. EPA 1974). The Occupational Safety and Health Administration establishes workplace exposure guidelines that require hearing protection for people working at or in close proximity to noise levels above 85 dBA. The acceptance threshold for impulsive noise is 61 C-weighted decibels (dBC) C-weighted day-night level (CDNL) (without hearing protection). The peak overpressure for 2.0 pounds per square foot (psf) is 45 dBC CDNL and the peak overpressure for 3.1 psf is 48.6 dBC CDNL (Appendix B, Figure 3-2). The threshold for impulse noise sound pressure level is 140 dBC CDNL (National Institute for Occupational Safety and Health 1986) or 4.4 psf. The threshold for non-impulse noise is 65 dBA DNL (without hearing protection), which is equivalent to 61 dBC CDNL (Appendix B, Table B-2). Two factors that

help determine the levels of annoyance for sonic booms are frequency and sound level. Figure 3-2 in Appendix B shows the level of acceptability for sonic booms based on the frequency and peak overpressure.

3.2.2 Noise/Sonic Boom Avoidance Areas

The FAA has identified in FLIP AP/1B several locations within the Region of Influence as avoidance areas. A list of these avoidance areas is provided in Appendix B. The Air Force requires that any planned supersonic operations be conducted under the following conditions with appropriate consideration/ evaluation of environmental impacts:

(1) Over open water areas, above 10,000 feet MSL, and more than 15 nautical miles (NM) from any land areas;
(2) Over land areas, above 30,000 feet MSL;
(3) Avoid areas of population concentration and "Avoidance Locations" as well as Headquarters U.S. Air Force specified critical areas listed in FLIP AP/1B; and
(4) If units require flight operations outside of the parameters of (1) or (2), then they are required to submit a waiver request with an appropriate level of environmental analysis.

3.2.3 Affected Environment for Noise

3.2.3.1 Affected Environment for Takeoff and Landing at Edwards AFB

Noise contours for Edwards AFB, as shown in Figure 3-2, were updated in 2004. The noise at Edwards AFB is highest around the airfield, NASA DFRC, industrial areas, Cords Road, the Alpha Corridor, and the Precision Impact Range Area (PIRA). The noise contours resulting from subsonic aircraft operations in restricted area R-2515 range from 55 dB L_{dn} to less than 45 dB L_{dn} (95th Air Base Wing [95 ABW] and AFFTC 2005a); no noise above 60 dB L_{dn} would be expected in restricted area R-2515 or at Edwards AFB. The noise levels near the residential areas and at the perimeter of the base remain below 65 dB Community Noise Equivalent Level.

Noise from sonic booms is addressed in the *Environmental Assessment to Extend the Supersonic Waiver for Continued Operations in the Black Mountain Supersonic Corridor and Alpha Corridor/Precision Impact Range* (AFFTC 2001) and the *Environmental Assessment for the Continued Use of Restricted Area R-2515* (AFFTC 1998). Supersonic noise in the R-2515 restricted airspace is generated from

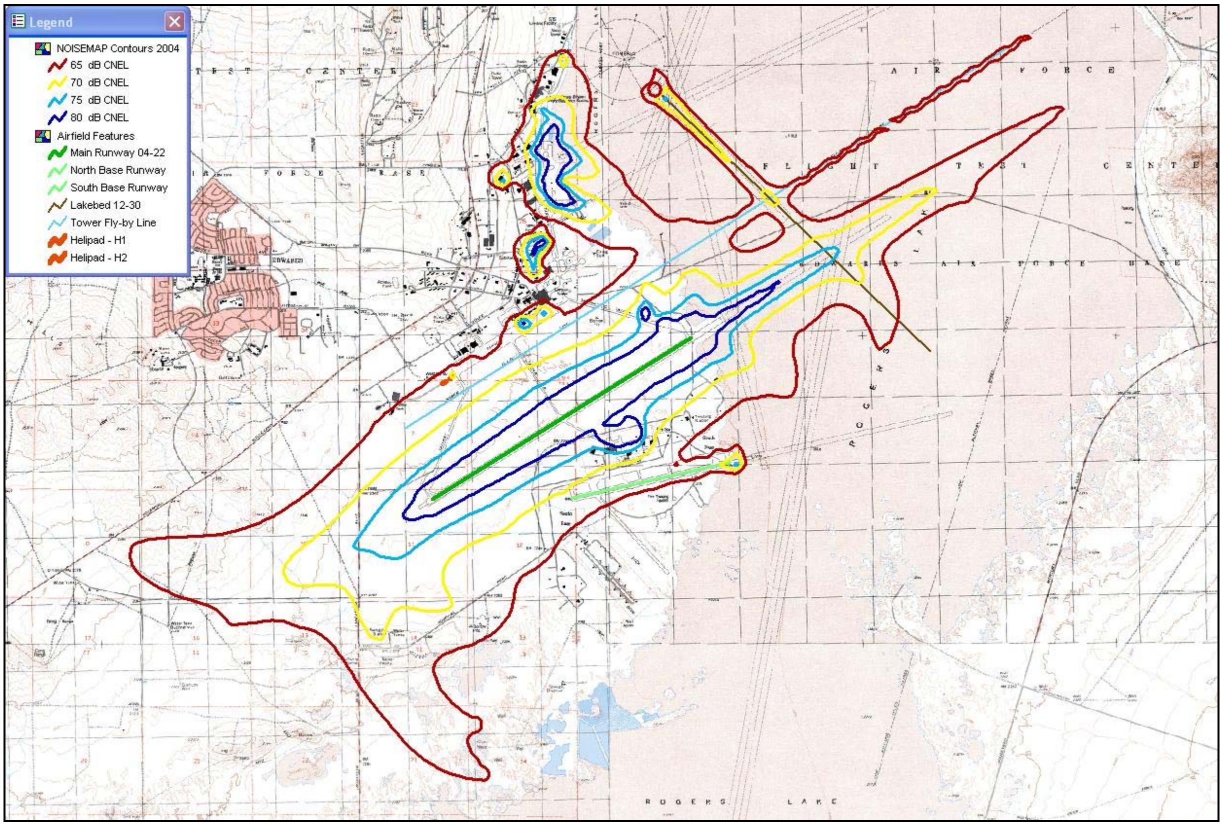


Figure 3-2

Noise Contours at the Runways at Edwards AFB

supersonic flight operations occurring in the Black Mountain and High Altitude supersonic corridors and Alpha Corridor/PIRA area. The predicted cumulative noise level contours for current operations are based on 1999–2000 data. Aircraft traveling at or above the speed of sound produce sonic booms with a noise level of 61 dBC CDNL and lower within restricted area R-2515 (95 ABW and AFFTC 2005a).

It was estimated that approximately 616 supersonic flights were conducted annually within the Edwards AFB supersonic corridors between 1980 and 2003. On average, 182 supersonic flights occurred between 10,000 and 30,000 feet MSL and 438 supersonic flights occurred above 30,000 feet MSL (Lane 2008). Overpressures for the majority of sonic booms were a nominal 1.3 psf (AFFTC 2001).

3.2.3.2 Affected Environment for Flights above 3,000 Feet AGL within it Region of Influence

Background Noise Levels

Ambient noise levels on the ground outside of military operating areas and special use airspace would typically be low. Primary noise sources would include the wind and vehicular traffic along the roads.

Road noise varies from 60 to 90 dBA depending on the type and quantity of traffic. Other noise sources could include farm machinery (e.g., tractors), recreational equipment (e.g., boat motors, all-terrain vehicles, and snowmobiles), other aircraft, and animal noises (e.g., dogs barking, birds chirping, feral donkeys baying). In general, background noise levels are higher during the day than at night. In a typical rural environment, background noise is expected to be approximately 40 dBA during the day and 30 dBA at night (Harris 1979) or about 35 dBA DNL (Miller 2002).

Noise levels on the ground under the military operating areas and special use airspace would be similar to the noise levels within the R-2508 Complex.

R-2508 Complex

The total noise contours include the effects of distributed aircraft operations and those of low level and other test routes that lie within the R-2508 Complex. The DNL noise contours resulting from subsonic aircraft operations range from 45 to 60 dBA (up to 65 dBA at Ft. Irwin) within the R-2508 Complex (95 ABW and AFFTC 2005a). The ambient noise levels around military airfields range from 45 dBA to 80 dBA, but lie completely within the base boundaries. Sensitive noise areas would include national and state parks, national forests, recreational areas, cities, and incorporated areas including schools, hospitals, and residential areas. Additional detailed information on noise sensitive receptors found within the R-2508 Complex can be found in the *R-2508 Complex Environmental Baseline Study* (95 ABW and AFFTC 2005a).

Effects on Structures

Sonic boom overpressure is the typical metric used to evaluate sonic boom impacts on structures. The most common incidence of damage in structures is to glass, plaster, and bric-a-brac. Table B-4 in Appendix B shows that sonic booms with intensity up to 0.5 psf (88 percent of the flight trajectory) would result in no items being affected. Sonic booms with intensities of 0.5 to 2.0 psf (12 percent of the flight trajectory) could affect pre-existing cracks in plaster resulting in fine [cracks], extensions of existing [cracks], [cracks] over door frames, or [cracks] between some plaster boards. Pre-existing cracks in glass are rarely shattered; damage could result in partial cracks and extensions to existing cracks. Damage to already damaged roofs could result in slippage of existing loose tiles/slates and sometimes could create new cracks at nail holes in old slates. Existing cracks in stucco on outside walls could be extended. Bric-a-brac items, large goblets, or fine glass carefully balanced or on the edge of shelves could fall. Dust in chimneys could fall. The actual occurrence of damage depends upon a number of variables; most

important are the orientation of the object to the flight track, the condition of the object, and the stability of its location.

Normally, the components of a structure that are most sensitive to airborne noise are windows and, infrequently, plastered walls and ceilings. An evaluation of the potential peak sound pressures impinging on the structure is normally sufficient to determine the possibility of damage. In general, at sound levels with peak sound pressure above 130 dB (psf above 1.5 [Appendix B, Table B-3]), structural components could be affected.

Certain frequencies may be of more concern than others. For example, a frequency of 30 Hz can cause window breakage. This frequency is not in the general range of aircraft, but is in the range corresponding to the rotor frequency of helicopters (AFFTC 2001). However, sounds lasting more than 1 second above a sound level of 130 dB are potentially more damaging to structures (National Research Council/National Academy of Sciences 1977). Because the structural components of historical buildings and other historical sites could be more fragile than newer construction, the effects of aircraft noise on these sites could be more severe than on newer, modern structures. There are few scientific studies of such effects to provide guidance for their assessment. One study involved the measurement of sound levels and structural vibration levels in a superbly restored plantation house, originally built in 1795, and now situated approximately 1,500 feet from the centerline at the departure end of Runway 9L at Washington Dulles airport. Measurements were made in connection with the proposed scheduled operation of the supersonic Concorde airplane at Dulles (Wesler 1977). There was special concern for the building's windows, since roughly half of the 324 panes were original. No instances of structural damage were found. It was noted that despite the high noise levels during the Concorde's takeoffs, the induced structural vibration levels were actually less than those induced by touring groups and vacuum cleaning within the building itself. While the sonic boom contours for these flight trajectories show a scale from 0.2 to 3.0 psf, an overpressure above 1.0 psf only occurs in relation to the sonic boom at the beginning of a flight trajectory, and for 88 percent of the flight the overpressure is below 0.5 psf. If a sonic boom with intensity greater than 2.0 psf were to occur over the structures, one could reasonably assume that damage could occur.

A study by Sutherland *et al.* conducted in 1990 shows that for sonic booms with an overpressure of 2.0 psf or lower, the probability of damage to structures like adobe walls is 0.0042 (1 in 4,200). The probability for damage to adobe with a good roof is 0.0078 (1 in 7,800) and to adobe with no roof is 0.00068 (1 in 68,000).

Other sources of vibration that potentially affect the historic buildings and sites include visitors, administrative flights and flight tours, and naturally occurring thunderstorms. It is estimated that lightning strikes occur in California over 250,000 times per year. Approximately 20 thunderstorms occur in the Sierra Nevada mountain range annually with loud thunderclaps, which are similar in intensity to the noise from the low-intensity sonic booms.

Effects on Artifacts

The study by Sutherland *et al.* (1990) also shows that for a sonic boom of 2.0 psf or lower, the probability of damage to early American petroglyphs and caves is 0.011 (1 in 1,100). Although no specific results of impacts from noise and sonic booms on Native American artifacts could be cited here, based on Table B-4 in Appendix B and the study cited above, it could reasonably be assumed the potential impacts on these artifacts would be similar to the potential impacts on glass, bric-a-brac, large goblets, or other fragile items. If a sonic boom with intensity greater than 2.0 psf were to occur over the artifacts, it could reasonably be assumed that damage could occur; however, since the sonic booms would be below that value except during the initial acceleration phase over an area of approximately 0.0000021 percent of the Region of Influence (2,500 of 1,179,502,720 acres), the potential for damage to artifacts would be less than significant, especially if the launch point were adjusted to ensure no known artifacts were beneath the area projected to have the higher intensity sonic boom.

Effects on Wildlife Species

Wildlife response to noise can be physiological or behavioral. Physiological effects can be mild, such as an increase in heart rate, to more severe, such as effects on metabolism and hormone balance. Mild behavioral responses include head raising or body shifting, and more severe responses are typified by nest abandonment. Long-term exposure to noise could cause excessive stimulation to the nervous system and chronic stress that is harmful to the health of wildlife species and their reproductive fitness (Fletcher 1980, 1988).

Wildlife species beneath the lateral limits of the sonic boom footprint would be indirectly affected by the noise and vibration from sonic booms created by the flight vehicle. Noise and visual impacts on wildlife could occur during the portions of the flight tests conducted below 1,000 feet AGL, the altitude at which the most reaction to visual stimuli by wildlife occurs (Bowles *et al*. 1991; Lamps 1989). However, the only portions of the flight tests that would occur below 1,000 feet AGL would be the takeoff and landing, which would occur over Edwards AFB. The U.S. Fish and Wildlife Service (USFWS) considers aircraft flight below 2,000 feet AGL a potential concern for listed species or species of concern. In general, wild

animals respond to low-altitude aircraft overflight. The startle response to noise or a passing shadow is the most readily observed and documented response of wildlife to aircraft overflight, but the adverse effect of this response is considered to be of a short term (minutes), and this short-term response will not influence the demographic characteristics or spatial distribution of any wildlife species. Birds and mammals can habituate to (get accustomed to) noise (See list of studies in Appendix B.3). In experiments using 211 bird nests exposed to gunshots, blasting, and low-level aircraft overflight, no eggs or young were ever rejected (Bowles 1995). Adult peregrine falcons have been known to step on eggs or young and occasionally kick eggs out of the nests during rapid exits following gunshots and other explosions (Smith *et al.* 1988). The U.S. Forest Service found that eggs and young are only rarely ejected from the nest after a startle. Panic responses are induced only after close and abrupt approaches. Adults are very reluctant to leave the nest, and generally remain away for a minute or less. In literature review of raptor responses to aircraft noise (Manci *et al*. 1988), most studies did not show a negative response to overflight. Negative responses were normally associated with rotary-wing aircraft or jet aircraft that were repeatedly passing within one-half mile of the nests. Neither amphibians nor reptiles have been shown to have a well developed acoustic startle response (U.S. Forest Service 1992). Significant impacts on wildlife would not be expected to occur for any species beneath the flight path because there would be no visual reference to affect the wildlife since the flight vehicle would be well above 1,000 feet AGL and the wildlife would likely habituate to the infrequent noise of the sonic boom.

Effects on Ungulates (Elk, Antelope, and Bighorn Sheep)

A study of the effects of sonic booms/stress on ungulates (elk, antelope, and bighorn sheep) was conducted by Workman and Bunch in 1992 at the Air Force Gandy supersonic range (MOA) in western Utah and eastern Nevada. Both penned and free roaming animals were subjected to various types of disturbances, including people on foot, motorcycles, four-wheel drive vehicles, fixed wing aircraft, helicopters, and F-16 jet aircraft flown at subsonic and supersonic speeds. Results indicated that animals habituated to most disturbance factors in a short period of time. The exceptions included people on foot, fixed wing aircraft at low levels of flight, and helicopter flights at low altitudes near the animal enclosures. Animals habituated to subsonic and supersonic jet overflight after about four passes overhead. This habituation seems to be permanent, as these same animals did not respond when tested at a later date. Consequently, noise impacts on ungulates would not be expected to create any significant impacts if Alternative A were implemented.

Effects on Raptors

In 1990, Aubrey and Bowles studied the effects of sonic booms on raptors. Results showed that any direct evidence that raptors would abandon nests as a result of sonic booms was weak; there was no evidence to support the theory that sonic booms affected hatchability; startled birds spent an average of 6.5 minutes off the nest, while hunting flights by birds were usually longer than 30 minutes. Occasions when parent birds knocked eggs out of the nest were rare; many times perching birds would be flushed, while incubating birds would only be alerted by a sonic boom. Studies on the effects of sonic booms on bird eggs show that it would take a 250 psf boom to crack an egg. The highest recorded sonic boom, created by an F-4 military jet at traveling at Mach 1.26 and at 95 feet AGL, resulted in an overpressure of 144 psf. (Ting *et al.* 2001). Consequently, one could assume there would be no significant impact from sonic booms generated by these flight tests on raptors.

Effects on Migratory Birds

During flight tests, project personnel may encounter migratory birds and shall comply with all measures in the Migratory Bird Treaty Act. Aircraft strike hazards, the primary threat to migratory birds, would be the same for carrier and chase aircraft as for any other flight vehicle operating in the ROI. Most birds typically fly at altitudes below 500 feet AGL, although vultures sometimes rise over 10,000 feet (Stanford Alumni 2005). Long-distance migratory bird species start out at about 5,000 feet and climb to around 20,000 feet. Since most flight test vehicles would be operating above 20,000 feet, except during takeoff and landing at Edwards AFB, the potential for the test vehicle or support aircraft to impact birds would be the same as for other testing and evaluation aircraft missions. From 1985 to 1998, 168 incidents of bird strikes (12 per year) were reported for flight operations at Edwards AFB. Approximately 28 percent of those bird strikes occurred during low-altitude flight (Edwards AFB 2002). Since the test vehicle would be accompanied by a chase aircraft after it re-entered controlled airspace (about 5 NM from Edwards AFB), the pilot in command would provide visual cues to the pilot controlling the test vehicle to avoid any impact with flocks of birds that may be transiting the flight path. A comprehensive bird-aircraft strike hazard (BASH) program has been implemented at Edwards AFB to minimize habitat and vegetation that attract migratory and non-migratory species around the airfield. Vehicle flight tests faster than the speed of sound would not be expected to significantly increase the impact on bird species at Edwards AFB; therefore, additional mitigation beyond the current BASH procedures would not be required.

Effects on the Desert Tortoise

In 1999, Bowles, Eckert, Starke, Berg, and Wolski studied the effects of sonic booms on the desert tortoise. The tortoises were subjected to sonic booms up to 8 psf (sonic booms for the test vehicles would be from 0.2 to 2.0 psf) from an F-22 military jet at Edwards AFB, California, and Nellis AFB, Nevada. Two successive 6 psf sonic booms (almost twice the intensity of the most intense sonic boom [3.1 psf] created by the high-speed vehicle) showed no significant temporary threshold shift (TTS). Another study on the impact of low-level aircraft flights and sonic booms on desert tortoises determined they experience a temporary threshold shift in hearing, but recover rapidly (Bowles *et al*. 1999). Simulated overflight caused freezing in 30 percent of the initial tests, with habituation being rapid. Heart rate, metabolic rate, and body temperature were measured, but the effects were inconclusive. Consequently, one could assume that no significant impacts on the desert tortoise would result.

Effects on the Mohave Ground Squirrel

No direct impacts on the Mohave ground squirrel would be expected because no ground disturbance is anticipated. Sonic booms with an intensity of 0.2 to 2.0 psf would occur over the Mohave ground squirrel habitat. Because Mohave ground squirrels are not active during most of the year and spend about 8 months of the year underground, it could reasonably be concluded that the potential for impact due to the effects of noise and vibration created by the sonic boom on their habitat would be minimal for two-thirds of the year. Because only 48 flight tests and associated sonic booms would occur annually and the Mohave ground squirrel spends most of its' time below ground, one could reasonably conclude that impacts on the Mojave ground squirrel would be less than significant.

3.2.3.3 Environmental Consequences of Noise for Takeoff and Landing at Edwards AFB

Noise Footprint for a Typical Flight Test Takeoff and Landing

The noise associated with the takeoff and landing of the flight test vehicle would be similar for Alternatives A, B, C, and D. Under Alternative E there would be no engines and no noise would be produced by a flight simulation. The first noise produced for a typical flight test would occur during the startup of the aerospace ground equipment and carrier aircraft or flight vehicle engines. Once the engines were started, the engine noises associated with taxiing to the runway and taking off would be heard by base personnel, a normal everyday occurrence. Once airborne, the carrier aircraft or flight test vehicle would initiate a climb within the R-2508 Complex to a cruising altitude established by the test plan. Once the carrier aircraft and/or flight vehicle climbed above 3,000 feet AGL the noise level would be below 55

dBA on the ground, and once the carrier aircraft climbed above 6,000 feet AGL the noise level on the ground would be equal to or less than ambient conditions. If the flight vehicle was carried to the release altitude by another aircraft, no noise would be produced by the flight vehicle. If the flight vehicle launched using onboard engines, then noise would be generated, but would be expected to be similar to other high speed jet aircraft operating from the launch site at Edwards AFB. Upon landing at Edwards AFB, during an unpowered landing, the only sound from the flight vehicle would be the sound of the vehicle gliding to a landing on the runway. A powered landing configuration would be expected to be similar to other jet landings. The carrier and chase aircraft would make normal subsonic noise associated with landing of military aircraft; noise contours would be within restricted area R-2515. The number of flights would not change the noise contours at Edwards AFB or within restricted area R-2515. Consequently, the impact of noise during the takeoff and landing phase of the flight test would be less than significant.

3.2.3.4 Environmental Consequences of Noise for Flights above 3,000 Feet AGL for the Region of Influence

Noise Footprint for a Typical Test Flight above 3,000 Feet AGL

The carrier and chase aircraft would initiate their climb to cruise altitude per FAA air traffic controller instructions and remain within restricted area R-2508 to the maximum extent possible. Once above 6,000 feet AGL, the subsonic noise from these aircraft would be at or below the ambient noise levels; consequently, no noise would be heard from these aircraft. At the launch point when the flight vehicle accelerated to a speed beyond Mach 1 and climbed and accelerated to Mach 3.5 or higher, a sonic boom with intensity up to 3.1 psf would be heard. The area on the ground where the crescent-shaped cone of the sonic boom footprint would contact the ground would be less than a few thousand acres and the sound would be similar to the sound of a single thunderclap. Once the flight vehicle reached its cruising altitude, the noise of a 0.3 psf sonic boom would be heard along the trajectory. Figure 3-3 shows a typical sonic boom profile for a flight vehicle similar to the X43A. The variations and indentions shown on the contour close to the midpoint and end of the flight path are caused by changes in altitude as the flight vehicle transitions between various stages of flight as shown in Figure 3-4.

Project-Related Sonic Booms

Factors that affect the nature and extent of sonic boom overpressures include aircraft design and operation, and atmospheric effects. Pressure waves are generated any time the speed of an object exceeds the speed of sound, and thus are generated for all flights faster than the speed of sound. The duration of a

sonic boom is brief, lasting from 100 milliseconds for a fighter-plane sized vehicle to 500 milliseconds for a Space Shuttle sized vehicle. Generally, an increase in altitude increases the area exposed to the sonic boom; for every 1,000 feet in altitude, the width of the boom increases by 1 mile. However, these pressure waves do not always propagate to the ground where they are perceived as a sonic boom. For a vehicle flying straight, the maximum sonic boom pressure wave will occur along the flight path and decrease gradually to either side. Because of the effects of the atmosphere, there is a distance to the side of the flight path beyond which the sonic boom is not expected to reach the ground. This distance is normally referred to as the lateral cutoff distance. For flights at 70,000 feet MSL and above, the lateral cutoff distance is 35 NM either side of the centerline of the flight path. Additional information and two studies conducted on sonic boom analyses are provided in Appendix B.1 and B.2.

3.2.4 Noise/Sonic Boom Avoidance Areas

Flight tests would avoid sensitive areas and those avoidance areas listed in FLIP AP/1B. In accordance with Air Force requirements, this EA will be submitted as required by Air Force Instruction 13-201 for any flight test outside the parameters listed in Section 3.2.2.

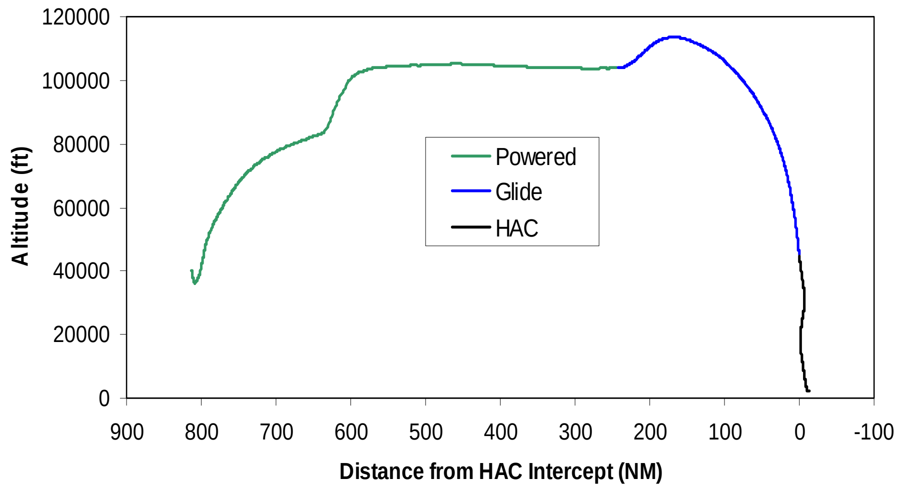
3.2.5 Alternative A, Proposed Action

Approved flight plans would avoid 85 to 90 percent of the population centers. Of the potential number of individuals who might hear the sonic booms, approximately 2 percent of the population beneath the flight path would be expected to be annoyed by the noise from the sonic boom if the environmental conditions were such that they heard the noise at all (based on data from Table B-2 and Figure 3-2 in Appendix B). A Category 1 sonic boom exceeding 2.0 psf would only occur during the initial launch phase of flight and would typically be limited to approximately 4 small, crescent shaped areas covering less than 0.0000021 percent of the ROI (2,500 of 1,179,502,720 acres). It is likely that the frequency of sonic booms would be lower for any particular area if Alternative A was implemented because a launch could occur over the Pacific Ocean for one flight test and the following flight could launch from the east.

Figure 3-3

Contour of a Typical Sonic Boom for Flight Vehicle Similar to an X43A

Source: 95ABW AFFTC 2005b



Source: 95 ABW AFFTC 2005a

Figure 3-4 Altitude vs. Distance Profile of the Trajectory

Because the noise levels would be below federal acceptability guidelines, and very widely distributed over the ROI, noise impacts from conducting these flight tests would be less than significant.

3.2.6 Alternatives B, C, and D

Similar to Alternative A, the noise from the sonic boom would also be expected to annoy 2 percent of the population beneath the flight trajectory if Alternatives B, C, or D were implemented. The frequency of sonic booms over a particular region would be greater if Alternative B, C, or D were implemented. However, as shown on Appendix B, Figure 3-2, even an increase to 10 sonic booms per day would be below the threshold level of acceptability. Although the Proposed Action and Alternatives would request up to 48 test flights per year, the flight test team expects that only 20 flights per year would actually occur. Consequently, the noise from the sonic boom would be heard, but would be less than significant.

3.2.7 Alternative E

The only noise created if Alternative E were implemented would be the noise from the computers and air conditioning units cooling the test office. The use of a computer simulation would not create any significant noise impacts.

3.2.8 Alternative F, No-Action Alternative

Alternative F (No-Action Alternative) is the status quo. Faster than the speed of sound flight tests would continue to occur in Air Force and FAA approved designated areas on an ad hoc basis rather than as part

of an integrated and coordinated program. Mission and flight test aircraft operating from Edwards AFB would comply with approved flight profiles per applicable DOD, Air Force, NASA, and AFFTC instructions.

3.2.9 Significance/Mitigation Measures

Noise from the sonic boom may be heard along any flight path used. The crescent shaped areas where the most intense noise would occur are limited to approximately 0.0000021 percent of the ROI (2,500 of 1,179,502,720 acres). The intensity and frequency would be low and widely dispersed. While this Category 1 level sonic boom would be below the standard threshold where a significant number of people would be highly annoyed, the mission profile could be adjusted so regions experiencing higher pressure levels would not be within any particular sensitive or avoidance areas, thus ensuring that impact from sonic boom noise would be less than significant. Site-specific NEPA analysis to determine noise impacts for specific regions would be conducted once the specific vehicle and flight paths are selected. Appropriate mitigation measures would be implemented as applicable.

3.3 AIRSPACE MANAGEMENT AND AIR SAFETY

This section provides a description of the airspace that could be affected by the proposed flight tests, the management of that airspace, and the safety requirements that apply to flight in the airspace up to the edge of space. The potential impacts and mitigation measures are then addressed.

3.3.1 Background

The airspace for Alternative A includes areas used by the military for test and training operations, routes used for commercial and private aircraft flights, and airports and airfields. All flight trajectories would remain within or above military airspace to the maximum extent feasible. When the flight vehicle is in flight at 60,000 to 264,000 feet MSL it would be significantly above the commercial and private flight routes, airports, and airfields. Until the flight vehicle reached 60,000 feet MSL, it would be controlled by Air Route Traffic Control Centers (ARTCCs).

The airspace is scheduled, monitored, regulated, and controlled to provide a safe aircraft flight environment. The flight vehicles would enter or fly over FAA controlled and uncontrolled airspace that is controlled by the ARTCCs in the Central and Western United States; these would include the Albuquerque, Ft. Worth, Houston, Kansas City, Chicago, Minneapolis, Denver, Salt Lake City, Seattle,

Los Angeles, and Oakland Centers. There were 21,925,264 controlled aircraft flights in FY 2007 for these centers, an average of 60,069 flights per day (FAA 2007).

Airspace management and air safety are central issues that must be evaluated to determine the potential impacts on other aircraft flying in the NAS. Airspace would be affected if any of the following occurred:

- Movement of other air traffic (civilian or commercial) in the area was restricted;
- Conflict with air traffic control along the flight path (e.g., see and avoid or communications) occurred; or
- There was a change in operation or designation of airspace used for other purposes (e.g., conflict with operations within the military operations areas (MOAs), restricted areas, and other special use airspace).

Management of flight vehicles traveling faster than the speed of sound, whether manned or unmanned, is still evolving. The approach to future management will likely continue to require programmatic coordination between the FAA for flights in the NAS and the DOD or NASA proponent. Since the initial vehicle configuration described is expected to be similar to a UAV, the rules and regulations for operating a UAV would be applicable when the vehicle operated in FAA controlled airspace. An EA and FONSI (95 ABW and AFFTC 2006) for the routine and recurring operation of UAVs landing at Edwards AFB describes the procedures for conducting test flights of UAVs that operate in the R-2508 Complex and in the FAA controlled NAS. Up to the present, for UAV flights operating within the NAS (outside restricted areas or warning areas), the Air Force has operated these aircraft under the Certificate of Authorization (COA) process. With the application of a COA, the proponent must identify and define specifics of the flight operations including proposed route of flight, altitudes, duration, and frequency of flight. Future procedures will be promulgated through the FAA rule-making process, which provides for public review and comment to ensure a level of safety for these flights which is equivalent to that accepted for existing manned aircraft operations. Individual COAs have relied on established procedures and provisions to ensure safe operations and have included some of the following, which would be applicable to these flight tests.

- Maintaining two-way radio communications between air traffic control (ATC) and the pilot in control via the UAV.
- Meeting the same requirements as commercial aircraft to operate effectively and safely within the airspace, operating under an instrument flight rules (IFR) clearance with ATC.

- Requiring altitude reporting by an altitude reporting transponder in the same manner as manned aircraft operating under IFR.
- Specifying altitude/route restrictions that prohibit other aircraft from entering an area used by the UAV.
- Employing high-altitude flight procedures (generally above 45,000 feet above MSL, but variable by location and potential for other air traffic) for UAV flights in the NAS without a chase aircraft.
- UAVs operated by a certified pilot or trained operator.

To further the safety analysis process, two quantitative risk analyses (Appendix C.1 and C.2) were completed to determine vehicle reliability requirements in relation to FAA, NASA, and Air Force safety standards.

3.3.2 Affected Environment—Airspace Management and Air Safety

3.3.2.1 Airspace Management

Airspace is defined as the space that lies above a nation and comes under its jurisdiction. Although it is generally viewed as being unlimited, airspace is a finite resource that can be defined vertically and horizontally, as well as temporally, when describing its use for aviation purposes. The FAA is charged with the safe and efficient use of the nation's airspace and has therefore established certain criteria and limits for its use. The FAA utilizes the NAS to accomplish this task. NAS is "...a common network of United States airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; and rules, regulations and procedures, technical information and manpower and material" (Jeppesen Sanderson, Incorporated 2000). No upper limit for the NAS has been defined; however, the FAA is considering establishing an upper limit in order to clearly define the FAA's responsibility for accommodating vehicles transitioning to and from altitudes above the NAS.

Within the United States, the FAA classifies airspace as either controlled or uncontrolled. Controlled airspace is an airspace within which ATC service is provided to IFR flights and visual flight rules (VFR) flights in accordance with a specific airspace classification (Class A, B, C, D, or E). Figure 3-5 shows the relationship of the various classes of airspace. Within controlled airspace, all aircraft operators are subject to certain pilot qualifications, operating rules, and equipment requirements. Uncontrolled airspace (Class G) is an airspace that is not classified by the FAA. All airspace above flight level (FL) 600 (60,000 feet MSL adjusted for pressure) is uncontrolled (Class E) airspace. Table 3-12 in Appendix C describes the

categories and classes of airspace controlled by the FAA. The carrier aircraft or flight vehicle would not fly in the Class B, C, or D airspace above local or regional airports, except for takeoff and landing at Edwards AFB.

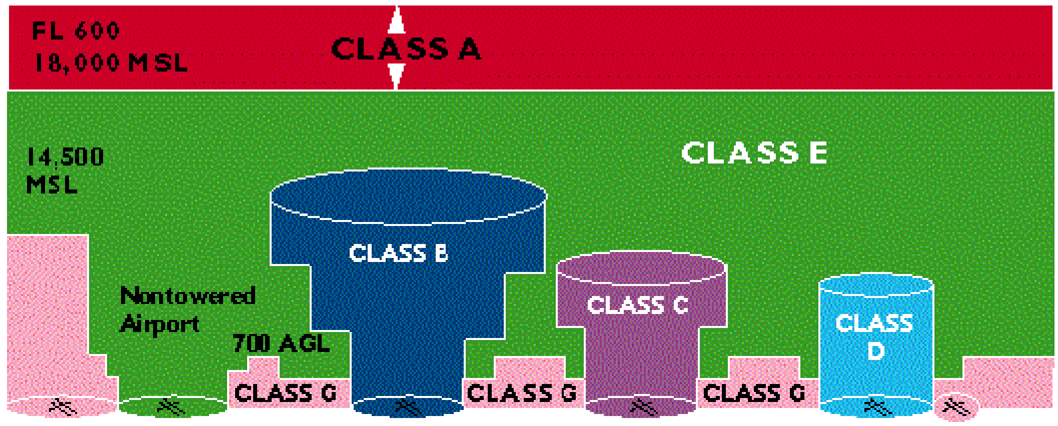


Figure 3-5 Classes of Airspace in the United States

Source: FAA 2008

Routes Used by Commercial and Private Aircraft

There are numerous en route, low-altitude victor airways (designated flight paths for aircraft up to, but not including, 18,000 feet MSL [a highway in the sky]) and high-altitude jet routes (FL 180–FL 600) that may transect the airspace beneath a flight vehicles flight path. The width of en route victor airways and jet routes is generally considered to be plus or minus 4 NM from the routes' centerline. Most commercial air traffic flies below 43,000 feet MSL, although some private jets reach an altitude of 50,000 feet MSL.

Airports and Airfields

The potential impacts on airports and airfields would be less than significant because the flight vehicles would be at least 25,000 feet above all airport control zones except for the Edwards AF Auxiliary North Base airfield and Edwards AFB during the landing phase of any flight test.

Affected Special Use Airspace

The special use airspace that could be affected by flight tests are shown in Table 3-6. Since the use of these areas are controlled by the same DOD schedulers that would be involved in scheduling the 48 annual flight tests under this small program, it could be assumed that no significant effects would result from test flights in this special use airspace.

Table 3-6

Special Use Airspace Affected By Flight Tests

Number/Name	Effective Altitude (feet)	Time of Use	Controlling Agency
R-2508 Complex			
R2502N	Unlimited	Continuous	HI-DESERT TRACON
R-2505	Unlimited	Continuous	HI-DESERT TRACON
R-2508	FL 200–Unlimited	Continuous	HI-DESERT TRACON
R-2515	Unlimited	Continuous	HI-DESERT TRACON
R-2524	Unlimited	Continuous	HI-DESERT TRACON
Bishop MOA	200 AGL[2]	0600–2200 M–F[1]	HI-DESERT TRACON
Isabella MOA	200 AGL[2,3]	0600–2200 M–F[1]	HI-DESERT TRACON
Owens MOA	200 AGL[2,4]	0600–2200 M–F[1]	HI-DESERT TRACON
Panamint MOA	200 AGL[2]	0600–2200 M–F[1]	HI-DESERT TRACON
Saline MOA	200 AGL[2]	0600–2200 M–F[1]	HI-DESERT TRACON
Shoshone MOA	200 AGL[2]	0600–2000 M–F[1]	ZLA CNTR

Notes:
1 Other times by NOTAM.
2 Up to but not including FL 180.
3 Excluding 3,000 feet AGL and below over Domeland Wilderness Area.
4 Excludes area over 3,000 feet AGL over Wilderness Areas, National Parks, and Monuments.
AGL above ground level
ARTCC Air Route Traffic Control Center
CNTR Center (ARTCC)
FL flight level (FL 180 = approximately 18,000 feet above mean sea level)
MOA Military Operations Area
NOTAM Notice to Airmen
R restricted
TRACON Terminal Radar Control
ZLA Los Angeles ARTCC

Sources: National Aeronautical Charting Office 2006a, b, c, and d.

The flight trajectory of the test vehicle would be above 60,000 feet MSL after 2 minutes of flight time. The vehicle would be above most other special use airspace and MOAs in the ROI until it returned for landing at Edwards AFB via the R-2508 Complex.

3.3.2.2 Air Safety

Air safety is integral to commercial, private, and military flight operations. Overall public health and safety is controlled by a host of legislation (Occupational Safety and Health Administration regulations and NASA Safety Program requirements are applicable as well as the FAA regulations at 14 CFR Parts 400–450) that regulates transportation of hazardous cargo, provides for the protection of workers in the work place, protects the public from exposure to hazardous materials, and provides for emergency preparedness.

The FAA, Air Force, and NASA have safety programs in place that identifies specific requirements that must be met prior to launching and flight testing vehicles that operate in uncontrolled Class G airspace. The FAA does not license launches performed by, or with substantive involvement of, federal

The FAA does not license launches performed by, or with substantive involvement of, federal government agencies (like the Air Force and NASA). The primary objective of the FAA's commercial space transportation licensing program is to ensure public health and safety through the licensing of commercial space launches and reentries and the operation of launch facilities. For all commercial launches, the FAA licensing process includes a pre-licensing consultation period and an application evaluation period that consists of a policy review, payload review, safety evaluation, financial responsibility determination, and an environmental review. The FAA issues a license when it determines that an applicant's launch or reentry activities or proposal to operate a launch facility will not jeopardize public health and safety, safety of property, national security or foreign policy interests, or international obligations of the United States. The Air Force, as part of DOD, relies on DOD Range Safety Standards (Range Commanders Council Standard 321-02) for guidance on air safety requirements which are similar to the FAA licensing requirements. The FAA and Air Force have signed a memorandum of agreement relating to space transportation and range activities to ensure commercial launches from federal facilities abide by the same stringent safety standards as required for other commercial space launch and reentry activities.

3.3.3 Environmental Consequences on Airspace Management and Air Safety

3.3.3.1 Environmental Consequences on Airspace Management

The primary impact on airspace management for the Proposed Action and Alternatives would result from additional flight operations by carrier and chase aircraft operating in the FAA-controlled NAS and flight vehicles operating in and above the FAA-controlled NAS. The flight operations would increase by an extremely small number and percentage. The projected number of flight operations—when compared to the level of flight activity controlled by the eleven ARTCCs within the ROI—represents a less than 0.0000022 percent increase in flight operations. Consequently, there would be no significant impact on airspace management if the Proposed Action or Alternatives were implemented.

3.3.3.2 Environmental Consequences on Air Safety

Potential air safety impacts, as with the operation of any aircraft, would be related to the reliability of the support aircraft and the flight vehicles' ability to see and avoid other aircraft as well as the pilots' and trained operators' ability to deal with contingencies, without creating additional risks to people, other aircraft, or property. Pilots, trained operators, and chase aircraft, or a combination of these, would provide a margin of safety so the flight vehicle could see and avoid other aircraft and thus reduce the risk

to people, other aircraft, and property. The criterion for reliability and adequacy of safeguards is integral to the safety analysis completed by the Range Safety Office for each flight test program. As shown in the two Quantitative Risk Analyses (Appendix C.1 and C.2) safety and reliability factors would have to be met before a test flight could occur. Both the FAA and Air Force have teams of safety specialists that ensure safety requirements have been met. Consequently, the flight-testing of any flight vehicle under this program would only occur after these stringent requirements have been met.

3.3.4 Alternative A, Proposed Action

3.3.4.1 Controlled and Uncontrolled Airspace

The flight vehicle would operate in controlled airspace at an altitude and in an area where other aircraft could be co-located for only a short period of time immediately after launch and during final descent. For the majority of the flight tests, the flight vehicle would be above NAS-controlled airspace. Due to the steep landing trajectory of the flight vehicle, it would not re-enter NAS controlled airspace (at 60,000 feet MSL) until it was within the R-2515 restricted area and preparing to land on Runway 22 at Edwards AFB. While the flight vehicle was at aircraft altitudes of less than 50,000 feet, the mission would need to be coordinated with the FAA and ATC to ensure other aircraft remained clear of the flight vehicle. Under routine test conditions, this would only occur at the beginning of the flight profile after the flight vehicle was released from the carrier aircraft and within approximately 10 miles of the launch location, and at the end of the flight profile inside restricted area R-2515.

In the event of any emergency landing during the flight tests, the U.S. Air Force would relay all required airspace requests to terminal radar control (TRACON) for coordination with the appropriate ARTCC. Under emergency conditions there would be a temporary reduction in navigable airspace as air traffic was cleared from, and re-routed around, the airspace within plus or minus 5 minutes of the projected flight time of the flight vehicle, similar to the return of the Space Shuttle for a landing at Edwards AFB or at Kennedy Space Center in Florida. However, this type of activity is normal for the ARTCCs.

During short portions of flight just after launch and during the final descent (when the vehicle flies at aircraft altitudes), coordination with other aircraft traffic and air traffic controlling agencies would occur. The only conflict with commercial aircraft traffic would be immediately following launch for flights that do not begin in restricted airspace. The final approach and landing would be within the Edwards AFB restricted airspace and would not conflict with commercial air traffic, with the exception of a small portion of the landing entry point that may lie outside the restricted airspace and thus would require coordination with the High Desert Terminal Radar Control. Also, unless the flight vehicle is extremely

reliable, the risk to uninvolved aircraft from accident debris would exceed safety criteria in the region directly beneath the flight path. Therefore, test flights within this region would also require coordination with the FAA, and aircraft keep-out zones (even outside restricted airspace) may be used to manage this risk.

3.3.4.2 Special Use Airspace

Conducting these flight tests would have no significant impacts on the existing special use airspace because this airspace designation was created to support these types of flights.

R-2508 Complex

The flight vehicle would enter the R-2508 Complex; however, these areas would not be adversely affected since accommodating test vehicles would be considered a matter of routine operations in that special use airspace. The agency using the restricted areas coordinates with the Central Coordinating Facility (CCF), who has the autonomous authority for the R-2508 Complex shared-use airspace. The CCF acts as the single point for coordinating activities with High Desert TRACON and other ATC/mission control facilities. The annual number of flights within the R-2508 Complex from 1997 to 2002 was 35,037 (95 ABW and AFFTC 2005a). The addition of up to 48 flights would represent an increase of less than 0.0014 percent. Based on this extremely small increase, no significant impacts on special use airspace would be expected.

3.3.4.3 En Route Victor Airways and Jet Routes

Instrument flight rules aircraft using the en route victor airways and jet routes, and VFR traffic below 18,000 feet AGL, would be vertically separated from the vehicles' flight path by 20,000 to 50,000 feet MSL until the vehicle entered the restricted area R-2515 in the R-2508 Complex. Therefore, one could reasonably conclude that no impacts would be expected due to normal flight tests of the flight vehicle.

General aviation VFR traffic below restricted area R-2508 (which extends from FL 200 to an unlimited altitude) could potentially be affected by vehicle flight tests and landings. However, as noted above, the impacts would be short-lived and temporary, with adequate notification provided by the TRACON, local flight service stations, and Notices to Airmen (NOTAMs).

In the event of an emergency landing, the U.S. Air Force would relay landing requests to the FAA ATC Command Center for coordination with the ARTCC, depending on the location of the flight vehicle at the time of the emergency. Emergency situations are evaluated and handled by ATC on a case-by-case basis,

with an emergency flight vehicle or any aircraft experiencing an emergency being afforded priority handling over all other traffic. Under these emergency conditions, there would be a temporary reduction in navigable airspace if air traffic was re-routed to avoid the emergency.

3.3.4.4 Airports/Airfields

Flight testing would not adversely affect airports and airfields beneath the ROI because the flight vehicle would be vertically separated from all airports and airfields outside the R-2508 Complex by 30,000 to 60,000 feet except when launched or during landing.

3.3.4.5 Air Traffic Control

When unmanned, the flight vehicle falls into the category of remotely operated aircraft, and as such, requires approval for operations in the R-2508 Complex. Chapter 2.7 of *The General Operating Procedures for R-2508 Complex* (Edwards AFB 2004a) provides a detailed list of requirements for operating a remotely operated aircraft. As an unmanned vehicle, it is autonomous; the only operator control is provided by an up-link of the flight termination system (FTS), which can be used to break up the vehicle and prevent an impact in an undesirable location. Once the flight vehicle is launched, the FTS is operational. If the vehicle's flight profile deviates outside the parameters established by the safety plan, if there is a loss of signal, or if there is a loss of a specific data link command, the flight vehicle can be terminated by the Range Safety Officer.

As the flight vehicle entered the controlled airspace of the NAS at FL 600, approximately 5 NM from where the vehicle sets up for landing at Edwards AFB, mission control would ensure that the vehicle's trajectory conformed to the planned flight path. The active flight path would be dynamically reserved and released as the flight vehicle proceeded along the flight path. With the assistance of conflict prediction and resolution advisories, ATC would ensure that non-participating aircraft remained separated from the active portion of the flight path.

When the flight vehicle was in the glide phase of flight, positive ATC would not be an option since the vehicle would not be able to respond to the full range of ATC clearances. During descent, these flight vehicles have a higher descent rate than powered vehicles and they, therefore, must anticipate any constraints to landing, since landing at a contingency landing site for the specific mission would need to be identified as soon as possible.

Trajectory modeling identifies the point at which the flight vehicle is committed to land at Edwards AFB. This point represents the final opportunity to invoke a plan to land at a contingency site. Mission Control and ATC maintain communications in case a contingency plan must be implemented.

When the flight vehicle reaches its commitment point, it is handled as a priority vehicle since it does not have the option of deviating from its landing plan. The NAS Decision Support System provides sequencing and scheduling advisories to create an arrival slot to accommodate the landing. When the flight vehicle lands at Edwards AFB, AFFTC and NASA assume responsibility. When the vehicle touches down, the vehicle operator issues a notification that the mission has been completed, and the notification is disseminated via the NAS Wide Information System (FAA 2004).

Due to the small number of flights anticipated per year (four or fewer per month), and that ARTCC's normal duties involve routing and rerouting aircraft to avoid potential midair collisions, no significant impacts on ATC are anticipated.

3.3.5 Alternatives B, C, and D

Under Alternatives B, C, and D the impacts on controlled and uncontrolled airspace, special use airspace, airports and airfields, and air traffic control would be similar to those described for Alternative A. Because four or less flight tests would occur during any given month, with no more than one occurring per week, it is reasonable to assume that this small increase in the number of flight operations would be less than significant when compared to the hundreds of thousands of flights that currently occur within the region.

3.3.6 Alternative E

Under Alternative E, there would be no impact on airspace or air safety since no actual flight would occur.

3.3.7 Alternative F, No-Action Alternative

Under Alternative F, the No-Action Alternative, flight test of other vehicle capable of speeds in excess of the speed of sound would not be established at Edwards AFB. Commercial, military, and civilian aircraft would continue to use the controlled and uncontrolled airspace of the NAS. There would be no additional impacts on airspace management and air safety resulting from the No-Action Alternative.

3.3.8 Significance/Mitigation Measures

Flight operations for all flight vehicles operating in the NAS, R-2508 Complex, restricted area R-2515, and at Edwards AFB will be accomplished in accordance with strict guidelines promulgated by the Air Force, NASA, and FAA. Additional NEPA documentation may be required based on the specific nature of the future test programs and test vehicles. Test plans will require the flight test vehicle to meet the reliability standards established by the Range Commanders Council, Eastern and Western Range, NASA, and FAA. Prior to the launch, temporary surveillance areas, road closures, and/or airspace closures would be implemented as required by the mission-specific launch and safety plan. Coordination with the FAA ARTCCs to clear the area in front of and beneath the flight path would minimize the probability of impact with any commercial or private aircraft. This would reduce the potential for impacts on aircraft to minor significance; and ensure the operation of flight vehicles were within the capacity of the impacted system to absorb or mitigate with little effort and resources. Surveillance of non-mission aircraft would be required to ensure no significant impacts occurred.

By following these guidelines, which include training requirements for pilots and test flight vehicle operators and vehicle safety analyses, the impacts on airspace management and air safety would create impacts that are less than significant. The Air Force and NASA would continue to conduct operational flight tests in accordance with best management practices.

4.0 CUMULATIVE IMPACTS

The CEQ regulations define "cumulative impact" as the impact on the environment from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The U.S. EPA suggests that in reviewing cumulative impacts, the reviewers should focus on specific resources and ecological components that can be affected by the incremental effects of the proposed actions and other actions in the same geographic area. The U.S. EPA identified 10 ecological processes (U.S. EPA 1999) that should be evaluated to determine potential adverse effects on habitat and ecological resources:

1. Habitats Critical to Ecological Processes. Loss of keystone habitats, such as desert springs, native grasslands, coastal sage scrub, and riparian forests and wetlands are not planned. No construction on undisturbed land is planned. Flight vehicles would use existing runways and previously disturbed areas for launch and recovery activities.

2. Patterns and Connectivity of Habitat Patches. Since no new construction, ground disturbing activities, or changes in land use are planned, there would be no expected loss of rare habitats, loss of connectivity among habitat patches, or change in homogeneity across the landscape.

3. Natural Disturbance Regimes. No natural disturbance regimes such as fire, flood, or insect infestations, or ground disturbing activities would be expected to result from the Proposed Action or Alternatives. Increases to water sources, streams that would increase the vegetation in the desert climate, are not planned; as such additional fire sources or food sources for insects would not be expected.

4. Structural Complexity. Loss or reduction of components that create structural diversity, such as coarse woody debris, Joshua trees, and downed trees; reduced structural complexity in riparian areas; and reduced complexity of micro-site structures would not be anticipated.

5. Hydrologic Patterns. Changes in water chemistry, including temperature changes, reduced infiltration, increased surface flow, and wider swings in flow and increase flashiness, would not be expected. Construction activities that might alter the hydrologic patterns are not planned.

6. Nutrient Cycling. Because direct or indirect contact with the habitat would be limited, a disruption of feedback loops that conserve and recycle nutrients or increase leaching of nutrients from the system, or alter levels and normal patterns of variation of nutrients would not be expected.

7. Purification Services. The method by which the ecosystem breaks down waste and detoxifies contaminants and the ability of the system to process waste materials, toxics, or other contaminants would not be affected because wastes would be managed and disposed per specific federal and state guidelines.

8. Biotic Interactions. Changes to the biota are not planned. Contact with sensitive species would be limited because sensitive species are not known to be present on the runways and other previously disturbed areas. Ground disturbing activities would be limited to previously disturbed areas.

9. Population Dynamics. Mechanisms that tend to damp down fluctuations in populations, increase overpopulation irruptions, and cause population crashes would not be affected because of the extremely limited contact as noted above.

10. Genetic Diversity. Loss of genotypes, a reduction in generic variation, and genetically based deformities and reproduction dysfunction would not be expected because activities would be limited to runways and previously disturbed areas, thus minimizing any potential for affecting genetic diversity.

Table 4-1 summarizes the potential impacts on the 10 ecological processes the U.S. EPA has specifically identified for potential adverse impacts.

Table 4-1 Impacts on U.S. EPA's 10 Ecological Processes

Ecological Process	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
1	None	None	None	None	None	None
2	None	None	None	None	None	None
3	None	None	None	None	None	None
4	None	None	None	None	None	None
5	None	None	None	None	None	None
6	None	None	None	None	None	None
7	None	None	None	None	None	None
8	None	None	None	None	None	None
9	None	None	None	None	None	None
10	None	None	None	None	None	None

The data in Table 4-1 were determined by considering:

- Whether the resource is especially vulnerable to incremental effects;
- Whether the proposed action is one of several similar actions in the same geographic area;
- Whether other activities in the area have similar effects on the resource;
- Whether these effects have been historically significant for this resource; and
- Whether other analyses in the area have identified cumulative effects.

Additionally, the reviewers should determine whether the NEPA analysis has used geographic and time boundaries large enough to include all potentially significant effects on the resources of concern. Geographic boundaries should be delineated and include natural ecological boundaries and the time period of the project's effects.

The adequacy of the cumulative impact analysis depends upon how well the analysis considers impacts that are due to past, present, and reasonably foreseeable actions. This can be best evaluated by considering whether the environment has been degraded (to what extent); whether ongoing activities in the area are causing impacts; and the trend for activities and impacts in the area (U.S. EPA 1999).

The ROI for cumulative impacts analysis includes Edwards AFB, restricted area R-2515, the R-2508 Complex, and airspace above the western United States. Specific projects that have occurred, those currently taking place, and those projected for the future are identified in Table 4-2.

4.1 PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS

Over 90 to 95 percent of the past, present, and reasonably foreseeable actions occurring at Edwards AFB, restricted area R-2515, and R-2508 Complex are associated with ongoing operations at Edwards AFB, Naval Air Weapons Station (NAWS) China Lake, and Ft. Irwin Training Center.

4.1.1 Air Quality

The potential cumulative air quality impacts would result from operations occurring below and above 3,000 feet AGL. Emissions created by flight activity below 3,000 feet AGL would be well below *de minimis* threshold levels. The aviation sector currently emits about 2.6 percent of the nation's greenhouse gas emissions, with the United States military contributing only a small portion. Military aviation used

Table 4-2

Projects with Potential Cumulative Impacts

Project	Description	Potential Cumulative Impacts
Routine and Recurring Flight Operations at Edwards AFB	Approximately 10,500 flight operations are conducted per year at Edwards AFB.	Minimal. Up to 48 additional flights per year requiring terminal radar control (TRACON) monitoring and flight management.
Edwards AFB Runway Replacement Project	The main runway is being replaced in three phases. Project should be completed by the end of 2008.	None. Project should be completed prior to start of testing.
Testing and Evaluation of Directed Energy Systems	Testing laser and high power microwave systems against targets at Edwards AFB. Projected from 2006-2012.	Minimal. Up to 48 additional flights per year requiring TRACON monitoring and flight management.
West Mojave Plan	Covers 9.4 million acres including most of the California West Mojave Desert. Objective is to conserve and protect desert tortoise, Mohave ground squirrel, and over 100 other species.	None. No direct contact with any of these species is expected. Flights will fly over area, infrequent noise would be heard on the ground; however, all aircraft would be above 3,000 feet except when landing at Edwards AFB.
Installation of New Urban Operations Complex and Targets and Unmanned Aerial Vehicle (UAV) Targets for Nevada Test and Training Range	Urban target sites are being constructed for testing of UAV sensor and weapon systems against similar real world threats.	None. Flight vehicles would be above 60,000 feet in proximity to these sites, an altitude well above the UAV operational altitudes.
Livestock Grazing Authorization	Permit grazing by various types of livestock on BLM lands at various sites beneath the corridors.	No direct contact with any of these grazing areas is expected. Infrequent noise would reach the ground; no anticipated long-term effects.
Naval Air Weapons Station (NAWS) China Lake	Testing and training on the ranges at NAWS China Lake support Department of Defense (DOD) and National Aeronautics and Space Administration (NASA) flight and ground operations.	None. Flight vehicles would be above 60,000 feet in proximity to NAWS China Lake. Additional proposed flights would require TRACON monitoring and flight management which is part of normal activity.

Table 4-2, Page 1 of 2

Table 4-2 (Continued)

Projects with Potential Cumulative Impacts

Project	Description	Potential Cumulative Impacts
California Wild Heritage Act of 2003	Designate certain public lands and rivers as wilderness and wild and scenic rivers.	No direct contact with any of these public lands or rivers is expected. Infrequent noise would reach the ground; no anticipated long-term effects.
Naval Air Station Lemoore Military Operations Area (MOA)	New military operations area would extend from 5,000 to 35,000 feet over parts of California.	None. Flight vehicles would be above 60,000 feet in proximity to NAS Lemoore MOA.
Low-Level Testing and Evaluation at Edwards AFB	Flight tests from Edwards AFB and other DOD and NASA aircraft use 30 previously established routes for low-level flight training.	Minimal. The additional flight tests would add more noise; however, because the noise would be infrequent and noise from low-level flights would mask the noise from these high altitude flights, no significant impacts would be expected.
Wind Energy Project for Eleven Western States	BLM studied the impacts of Wind Energy Development over the next 20-year period. Wind turbines are known to create noise and visual impacts in the immediate area.	None. The additional 48 annual flight tests would add more noise; however, because the noise would be infrequent and similar to the natural sound of an occasional thunderclap, no significant impacts would be expected.
Reconstruction of the Furnace Creek Water Collection System	The National Park Service proposes to rebuild the water collection system for improved drinking water. Noise and construction-related short-term impacts to wildlife are expected.	None. The additional 48 annual flight tests would add more noise; however, because the noise would be infrequent and similar to the natural sound of an occasional thunderclap, no significant long-term impacts would be expected.

Table 4-2, Page 2 of 2

approximately 0.5 percent of the United States aviation fuel in 2000. Consequently, one could assume that adding up to 48 flights per year would increase greenhouse gas emissions and effects on global climate change; however, the addition would be insignificant in comparison the millions of tons of emissions generated by commercial flights occurring nationwide. Edwards AFB and the Air Force have implemented numerous programs to reduce the greenhouse gas emissions, including a rideshare/flex schedule program, recycling, and other energy reduction measures (e.g.,, replacing incandescent lights and adjusting thermostats to reduce the demand for electricity).

4.1.2 Noise

Several sources of noise were evaluated to determine if, when considered comprehensively, they would result in cumulative noise impacts. These include aircraft, transportation, construction, and detonation-related noise. The noise impacts of bombs, rockets, and missile detonations and sonic booms can result in a similar response. The aircraft generating sonic booms which impact the ROI operate in the High Altitude Supersonic Corridor, which lies directly above Edwards AFB. Use of the local supersonic corridor does create additional noise impacts; however analysis has shown these noise levels do not create a significant adverse impact (AFFTC 2001). The addition of up to 48 test flights would also create additional noise impacts; however, only a small percentage of those flight operations (up to 48 flights per year [although the more likely scenario would be 3 or 4 flights in one month separated by several months of inactivity and followed by 3 or 4 flights in another month], but still expecting less than one test per week) would create sonic booms. Based on past experience and data from Table B-2 in Appendix B, this infrequent noise would not create significant cumulative adverse noise impacts.

4.1.3 Airspace Management and Air Safety

With regard to other projects and flight operations occurring in the R-2508 Complex, the number of flight activities in special use airspace is strictly controlled, thus minimizing potential significance. Military flight activities occur in MOAs and special use airspace including the R-2508 Complex (including NAWS China Lake), other test ranges, and military operations areas; however, each range manages and controls the number of activities within its boundaries, thus limiting potential cumulative effects. Historically, the number and type of flight operations conducted in these special use airspace areas have not created airspace management or air safety issues because the flight planning and safety process has included risk analysis and the implementation of safety measures for each activity. Only flight activities that have met the flight safety criteria have been allowed to launch from Edwards AFB and operate in the R-2508 Complex. Because all flight activities in the R-2508 Complex are scheduled and limited by the

scheduling agency, the potential for cumulative impact has not been seen as a result of other proposed actions.

Cumulative air safety impacts for these flight vehicles are primarily affected by the number of aircraft being controlled, the airspace they are operating in, their reliability, and the capabilities of the pilot or trained operators. The cumulative number of aircraft is within the capacity of the controllers to manage and monitor. Scheduling is coordinated with local FAA representatives to ensure the number of flights launching from the facility is within their capability to handle safely. If there is a potential overload, the FAA can delay a launch until an opening into the NAS is available or put an aircraft in a holding pattern until a route is safe for the aircraft to continue. The launch and landing phase would be conducted in the special use airspace of the R-2508 Complex, an operating area specifically designated for this type of activity where it can be segregated from other air traffic. The vehicles would be evaluated and their reliability and specific safety requirements identified during the safety review process. These processes provide for a margin of safety to ensure that risk to the public is minimized and within established guidelines. Aircraft pilots and flight vehicle operators are highly trained for their specific type of aircraft or flight vehicle in strict compliance with FAA and/or DOD training standards. Consequently, cumulative air safety impacts would be minimized by the processes in place, thus ensuring that no significant impacts would result from normal flight operations.

4.1.4 Natural Resources

The flight tests would not create a significant cumulative impact on natural resources. The greatest potential for impacts on natural resources would be from the launch and landing phases at Edwards AFB and from the startle effect caused by the sonic booms. Although most of the operations would be above 3,000 feet AGL, the noise may produce a startle effect in some species. Studies have shown that wildlife habituate to noise or leave the area of high noise. Mitigation measures that minimize potential noise impacts from flight operations would be followed as identified in the R-2508 Complex User’s Handbook (Edwards AFB 2005).

4.2 SUMMARY OF ANTICIPATED ENVIRONMENTAL EFFECTS

Table 4-3 summarizes the anticipated environmental effects by resource area for the Proposed Action and Alternatives.

Table 4-3 Environmental Effects Summary

Resource Area	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Air Quality	Minor. Emission levels for ozone precursors would be 9 to 14 percent of the *de minimis* thresholds and less than 0.1 percent of total inventories for Kern County and AVAQMD. Carbon dioxide (a greenhouse gas) equivalent emissions (CO_2eq) would total 2,379.86 metric tons; however the base's Carbon Neutral Program would produce sufficient offsets to cover program.	Minor. Emission levels for ozone precursors would be 9 to 14 percent of the *de minimis* thresholds and less than 0.1 percent of total inventories for Kern County and AVAQMD. Carbon dioxide (a greenhouse gas) equivalent emissions (CO_2eq) would total 2,379.86 metric tons; however the base's Carbon Neutral Program produce sufficient offsets to cover program.	Minor. Emission levels for ozone precursors would be 9 to 14 percent of the *de minimis* thresholds and less than 0.1 percent of total inventories for Kern County and AVAQMD. Carbon dioxide (a greenhouse gas) equivalent emissions (CO_2eq) would total 2,379.86 metric tons; however the base's Carbon Neutral Program produce sufficient offsets to cover program.	Minor. Emission levels for ozone precursors would be 9 to 14 percent of the *de minimis* thresholds and less than 0.1 percent of total inventories for Kern County and AVAQMD. Carbon dioxide (a greenhouse gas) equivalent emissions (CO_2eq) would total 2,379.86 metric tons; however the base's Carbon Neutral Program produce sufficient offsets to cover program.	No change. Zero added emissions because flights would be conducted using computer simulations. Current operational effects on air quality would remain the same.	No change. Current operational effects on air quality would remain the same.
Airspace Management and Air Safety	Minor. Flight operations would increase by 0.0000022 percent annually. Flights could launch from any DOD or NASA	Minor. Flight operations would increase by less than 0.0000022 percent annually. Flights could launch from any DOD or NASA	Minor. Flight operations would increase by less than 0.0000022 percent annually because the region of influence (ROI) would be smaller	Minor. Flight operations would increase by less than 0.0000022 percent annually because the ROI would be smaller	No change. All testing would be conducted using computer simulations.	No change. Current operational effects on airspace management and air safety would remain the same.

Table 4-3, Page 1 of 3

1 **Table 4-3 Environmental Effects Summary (Continued)**

Resource Area	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Airspace Management and Air Safety (Continued)	facility, spaceport, or carrier aircraft in the Pacific or over continental United States and land at Edwards AFB.	facility, spaceport, or carrier aircraft in the Pacific or over the continental United States and land at Edwards AFB.	than for Alternative A. Flights could launch from any DOD or NASA facility, spaceport, or carrier aircraft in the Pacific or over the continental United States and land at Edwards AFB.	than for Alternative A. Flights could launch from any DOD or NASA facility, spaceport, or carrier aircraft in the Pacific or over the continental United States and land at Edwards AFB.		
Cultural	None	None	None	None	None	None
Environmental Justice and the Protection of Children	None	None	None	None	None	None
Geology and Soils	None	None	None	None	None	None
Hazardous Substances	None	None	None	None	None	None
Infrastructure	None	None	None	None	None	None
Land Use	None	None	None	None	None	None
Natural Resources	None	None	None	None	None	None
• **Desert Tortoise**	None	None	None	None	None	None
Noise/Sonic Booms	Minor. Approximately 2 percent of the population that noise/sonic boom	Minor. Effects would be similar to Alternative A, except flights would only occur	Minor. Effects would be similar to Alternative A, except the AOC would be reduced	Minor. Effects would be similar to Alternative A, except the AOC would be reduced	No change. All testing would be done using computer simulations. No	No change. No additional noise or sonic booms beyond those associated with

2 Table 4-3, Page 2 of 3

Table 4-3 Environmental Effects Summary (Continued)

Resource Area	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Noise/Sonic Booms (Continued)	could hear the would be expected to be annoyed if they heard it at all. Category 1 sonic booms exceeding 2.0 psf would occur during the initial launch and be limited to approximately 0.0000021 percent of the ROI (2,500 of 1,179,502,720 acres).	over the Pacific Ocean except for the landing in California. Category 1 sonic booms exceeding 2.0 psf would occur during the initial launch and be limited to approximately 0.0000024 percent of the ROI (2,500 of 104,772,480 acres).	in size to an area from the Rocky Mountains west to the Pacific Ocean and north from the Canadian border and south to the Mexican border. Category 1 sonic booms exceeding 2.0 psf would occur during the initial launch and be limited to approximately 0.0000036 percent of the ROI (2,500 of 688,263,040 acres).	in size to include only California, Nevada, Utah, Arizona, New Mexico, Colorado, Wyoming, Texas, Oklahoma, Kansas, Nebraska, and South Dakota. Category 1 sonic booms exceeding 2.0 psf would occur during the initial launch and be limited to approximately 0.0000028 percent of the ROI (2,500 of 878,054,400 acres).	noise or sonic booms would occur beyond those associate with existing programs.	existing programs. No change. No additional noise or sonic booms beyond those associated with existing programs.
Public/Emergency Services	None	None	None	None	None	None
Safety/Occupational Health	None	None	None	None	None	None
Socioeconomics	None	None	None	None	None	None
Water Resources	None	None	None	None	None	None

Table 4-3, Page 3 of 3

4.3 UNAVOIDABLE MINOR ADVERSE IMPACTS

Unavoidable adverse impacts include those impacts that are negative, occurring regardless of any identified minimization measures. Unavoidable impacts on natural resources are likely to occur. The Proposed Action would likely prevent the re-growth of small areas of terrestrial plant communities and the reintroduction of any wildlife habitat at the launch/landing site.

Typically the launch sites and landing sites for flight activities have been previously disturbed and they are located on active DOD and NASA installations, so the plant communities are of marginal quality for wildlife.

4.4 SHORT-TERM IMPACTS OR USES VERSUS LONG-TERM PRODUCTIVITY OF THE ENVIRONMENT

Examples of short-term uses of the environment include direct, construction-related disturbances and direct impacts associated with the indirect increase in population and activity that occurs over a period typically less than 5 years. Long-term uses of the environment include impacts occurring over a period of more than 5 years, including permanent resource loss.

Since no new development would be required under the proposed program and current Air Force or contractor personnel from other bases would be used for the program, neither Alternative A, B, C, D, E, or F would involve any short- or long-term changes in population or productivity of the environment.

4.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible and irretrievable resource commitments are related to the use of nonrenewable natural resources and the effects that the use of those resources will have on future generations. Irreversible effects primarily result from the use or destruction of a specific resource (e.g., fuel and minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of implementing an action (e.g., extinction of a rare or threatened species, or the disturbance of an important cultural resource site). In accordance with NEPA (40 CFR Part 1502.16), this section includes a discussion of any irreversible and irretrievable commitments of resources associated with the proposed project.

This programmatic EA is specific to flight testing of vehicles that would travel faster than the speed of sound in and above controlled and uncontrolled NAS in the western United States. These flight vehicles

would be above controlled airspace and at least 70,000 feet above the surface of the Earth except when initially launched from the carrier aircraft and when landing at Edwards AFB. To the maximum extent possible, these flight vehicles would be above DOD test ranges, restricted areas, warning areas, and MOAs and areas that are remotely populated. Implementing Alternatives A, B, C, or D would not require an irreversible or irretrievable commitment of resources, but would use resources typically made available for similar actions, such as aircraft flight tests. Implementing Alternative E, a computer simulation, or Alternative F (No-Action Alternative) would also not require an irreversible or irretrievable commitment of resources.

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8.0 ACRONYMS AND ABBREVIATIONS

95 ABW	95th Air Base Wing
AFB	Air Force Base
AFFTC	Air Force Flight Test Center
AFI	Air Force Instruction
AFRL	Air Force Research Lab
AGE	aerospace ground equipment
AGL	above ground level
ARTCC	Air Route Traffic Control Center
ATC	air traffic control
AVAQMD	Antelope Valley Air Quality Management District
Bash	bird-aircraft strike hazard
BLM	Bureau of Land Management
CAA	Clean Air Act
CCF	Central Coordinating Facility
CDNL	C-weighted day-night level
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
CO_2eq	carbon dioxide equivalent
COA	certificate of authorization
dBA	A-weighted decibels
dBC	C-weighted decibels
DFRC	Dryden Flight Research Center
DNL	day-night average sound level
DOD	Department of Defense
DOE	Department of Energy

EA	Environmental Assessment
EO	Executive Order
FAA	Federal Aviation Administration
FICUN	Federal Interagency Committee on Urban Noise
FL	flight level
FLIP AP	Flight Information Publication Area Planning
FONSI	Finding of No Significant Impact
FTS	flight termination system
GAO	Government Accountability Office
GHG	greenhouse gas
HAC	heading alignment circle
IFR	instrument flight rules
KCAPCD	Kern County Air Pollution Control District
LEV	lifting entry vehicle
MDAB	Mojave Desert Air Basin
MDAQMD	Mojave Desert Air Quality Management District
MOA	Military Operation Area
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NACO	National Aeronautical Charting Office
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NAWC	Naval Air Weapons Center
NAWS	Naval Air Weapons Station
NEPA	National Environmental Policy Act
NIOSH	National Institute for Occupational Safety and Health

NM	nautical miles
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NTTR	Nevada Test and Training Range
PIRA	Precision Impact Range Area
PM_{10}	particulate matter less than 10 micron
psf	pounds per square foot
QRA	quantitative risk assessment
ROI	Region of Influence
Sea Range	Naval Air Weapons Center Point Mugu Sea Range
SO_2	Sulfur dioxide
TRACON	terminal radar control
TTS	temporary threshold shift
UAV	unmanned aerial vehicle
U.S. EPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
VFR	visual flight rules
ZLA	Los Angeles Center

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Final

APPENDICES

ENVIRONMENTAL ASSESSMENT FOR FLIGHT TEST TO THE EDGE OF SPACE

December 2008

95th Air Base Wing
Environmental Management Directorate
Edwards Air Force Base, California

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The following appendices are **only** found on the compact disk.

APPENDIX B

APPENDIX B.1 NOISE AND SONIC BOOM ANALYSIS FOR HYPERSONIC CORRIDORS AT EDWARDS AIR FORCE BASE

APPENDIX B.2 NOISE AND SONIC BOOM ANALYSIS FOR EXTENDED RANGE HYPERSONIC CORRIDORS AT EDWARDS AIR FORCE BASE

APPENDIX C

APPENDIX C.1 QUANTITATIVE RISK ANALYSIS FOR HYPERSONIC CORRIDORS AT EDWARDS AIR FORCE BASE

APPENDIX C.2 QUANTITATIVE RISK ANALYSIS FOR EXTENDED RANGE HYPERSONIC CORRIDORS AT EDWARDS AIR FORCE BASE

APPENDIX C.3 EXPOSURE ANALYSIS FOR HYPERSONIC CORRIDORS AT EDWARDS AIR FORCE BASE

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A AIR QUALITY

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APPENDIX A—SUPPLEMENTAL AIR QUALITY DATA

Air Conformity

Federal facilities located in a NAAQS nonattainment area are required to comply with Federal Air Conformity rules and regulations in 40 CFR 51/93. Under Air Conformity, a facility (such as Edwards AFB) that initiates a new action must quantify air emissions from stationary and mobile sources associated with that action. Calculated emissions are first compared to established *threshold* emission levels (based on the nonattainment status for each applicable criteria pollutant in the area of concern) to determine the relevant compliance requirements. If the analysis finds that the project emissions are less than the *threshold* levels then a conformity determination is not required, and the analysis is documented with calculations and a letter signed by 95 ABW/CEVC. If the comparison finds that project emissions are equal to or greater than *threshold* levels, then the requirements of air conformity apply to the action. If formal air conformity determination is required, the SAF/MIQ must review and approve the analysis.

Within the State of California, the authority to regulate stationary sources of air emissions is delegated by the U.S. EPA to local air pollution control and air quality management districts (with state oversight provided by the California Air Resources Board (CARB). Authority to regulate mobile sources of air emissions resides with CARB. Local districts enact rules and regulations to demonstrate State Implementation Plan (SIP) goals. Edwards AFB is located within the jurisdiction of three local air districts: the Kern County Air Pollution Control District (KCAPCD), the Mojave Desert Air Quality Management District (MDAQMD), and the Antelope Valley Air Quality Management District (AVAQMD). The following paragraphs list the relevant regulations and *threshold* levels for each local air district used in the conformity analysis.

In accordance with the air conformity requirements of 40 CFR 51.853/93.153 (b)(1), and KCAPCD Rule 210.7, the *threshold* levels set for the 8-hr O_3 Basic nonattainment area of KCAPCD for O_3 precursor emission is up to 100 tons per O_3 precursor pollutant (NO_x and VOC) per year per action. *Due to recent court actions pertaining to EPA's implementation of the 8-hour O_3 standard, KCAPCD will be re-designated under Subpart II. This section will be updated with the appropriate threshold amounts when the re-designation occurs.*

In accordance with the air conformity requirements of 40 CFR 51.853/93.153 (b)(1) and MDAQMD Rule 2002, the *threshold* level set for the 8-hr O_3 Moderate nonattainment area of MDAQMD for O_3 precursor emissions is up to 100 tons per O_3 precursor pollutant (NO_x and VOC) per year per action.

In accordance with the air conformity requirements of 40 CFR 51.853/93.153 (b)(1) and MDAQMD Rule 2002, the *threshold* level set for the PM10 moderate nonattainment area of MDAQMD for PM10 emissions is up to 100 tons per year per action.

In accordance with air conformity requirements of 40 CFR 51.853/93.153 (b)(1) and AVAQMD Rule 1901, the *threshold* level set for the 8-hr O_3 Moderate nonattainment area of AVAQMD for O_3 precursor emissions is up to 100 tons per O_3 precursor pollutant (NO_x and VOC) per year per action.

In addition, pursuant to 40 CFR 93.153 (h)(3)(i), even if calculated emissions are less that *threshold* levels, a subsequent comparison must be made. Specifically, the calculated project emissions must be compared to the most current or applicable regional planning emission inventories for each criteria pollutant in the nonattainment area of concern. If the calculated emissions are equal to or greater than 10 percent of the regional planning emission inventory, then the action is considered to be regionally significant and the requirements of air conformity apply. Otherwise, if the calculated emissions are less than both *threshold* levels and 10 percent of the regional planning emissions inventories, then the requirements of air conformity do not apply to the action.

For KCAPCD, MDAQMD, and AVAQMD, the regional planning emission inventories for each district for O_3 precursor pollutant (NO_x and VOC) emissions are included in the most recent year California O_3 SIP. In the California O_3 SIP, the most recent regional planning baseline year is 2002 for MDAQMD and AVAQMD. For MDAQMD, the regional planning emission inventory for PM10 pollutant emissions are from the 1990 baseline year. For KCAPCD, the regional planning emission inventory for O_3 precursor emissions are also from the 1990 baseline year.

Tables A-1 through A-4 show the baseline values and projected inventories and their perspective 10-percent threshold values for each of the three districts. When comparing project emissions for conformity, it is appropriate to use the emission inventory value for the nearest year after the proposed project commencement date. For instance, if the project is scheduled to commence in year 2011 in the KCAPD, use the inventory for 2010. It is also appropriate to perform a linear interpolation to arrive at an estimate inventory value for the project year in question. *It should be noted that in the case of the three districts in questions, for all project years up to 2020, the project would exceed the 100 tons per year threshold before it exceeds the 10-percent level of significance.*

Table A-1

Kern County Air Pollution Control District (Eastern Kern County)

Baseline and Forecasted Emission Inventory (tons per year)

Year	VOC (ROG)	10 Percent	NOx	10 Percent
1990	10,184	1,018	17,100	1,710
1995	6,263	626	12,939	1,294
2000	5,125	513	13,206	1,321
2005	4,749	475	13,275	1,328
2010	4,387	439	12,928	1,293
2015	4,592	459	13,319	1,332
2020	4,555	456	13,319	1,332

Source: Kern County Air Pollution Control District, "Ozone Attainment Demonstration, Maintenance Plan, and Redesignation Request," Eastern Kern County Federal Planning Area, May 1, 2003, Appendix B (1990 Baseline).

Notes: NO_x – Oxides of Nitrogen
VOC – Volatile Organic compound

Table A-2

Mojave Desert Air Quality Management District

(Western Mojave Desert)

VOC, NO_x Baseline and Forecasted Emission Inventory

(tons per year)

Year	VOC (ROG)	10 Percent	NOx	10 Percent
2002	17,042	1,704	55,549	5,555
2008	17,480	1,748	52,034	5,203
2011	17,341	1,734	47,096	4,710
2014	17,338	1,734	43,143	4,314
2017	17,739	1,774	40,643	4,064
2020	18,462	1,846	39,723	3,973

Source: MDAQMD, "Federal 8-Hour Ozone Attainment Plan (Western Mojave Desert Non-attainment Area)", June 9, 2008, Appendix B (2002 Baseline)

Notes: NO_x – Oxides of Nitrogen
VOC – Volatile Organic compound

Table A-3

Mojave Desert Air Quality Management District

(Western Mojave Desert)

PM_{10} Baseline and Forecasted Emission Inventory

(tons per year)

Year	PM_{10}	10 Percent
1990 (c)	106,867	10,687
1994 (c)	98,128	9,813
1998 (c)	89,158	8,916
2000 (c)	85,050	8,505
2006 (d)	40,274	4,027

Source: Mohave Desert Air Quality Management District, "Final Mojave Desert Planning Area Federal Particulate Matter (PM_{10}) Attainment Plan," July 31, 1995, Appendix C (1990 Baseline)

Notes: PM_{10} – Particulate Matter less than or equal to 10 microns

Table A-4

Antelope Valley Air Quality Management District

Baseline and Forecasted Emission Inventory

(tons per year)

Year	VOC (ROG)	10 Percent	NOx	10 Percent
2002	17,042	1,704	55,549	5,555
2008	17,480	1,748	52,034	5,203
2011	17,341	1,734	47,096	4,710
2014	17,338	1,734	43,143	4,314
2017	17,739	1,774	40,643	4,064
2020	18,462	1,846	39,723	3,973

Source: Air Resources Board, 2006 Estimated (PM_{10}) Inventory for MDAQMD

Notes: NO_x – Oxides of Nitrogen
VOC – Volatile Organic compound

Air Conformity/National Environmental Policy Act (NEPA) Requirements

The Air Force is required to comply with the National Environmental Policy Act (NEPA) of 1969, and the Council on Environmental Quality (CEQ) regulations implementing NEPA. The Air Force Instructions implementing the NEPA requirements are contained in 32 CFR, Part 989, *Environmental Impact Analysis Process (EIAP)*. Air Conformity is addressed in Part 989.30 which states that all EIAP documents must address applicable Air Conformity (pursuant to 40 CFR 51.853/93.153(b)(1)) requirements and the status of compliance. The Air Conformity determination should be addressed prior to the completion of the EIAP so the information can be incorporated into the EIAP document (either a

Categorical Exclusion (CATEX), or Environmental Assessment/Finding of No Significant Impact (EA/FONSI). However, the Air Conformity analysis is a separate and distinct requirement that should also be documented separately. Per Air Force Instruction 32-7040, Air Quality Compliance, a conformity analysis must be completed for a project even when EIAP is not required. Current practice in 95 ABW/CEV is for Air Conformity letters for CATEX and Support Agreement documents (not requiring EIAP) to be on contractor letter head and signed by the contractor personnel completing the analysis. For EAs, the Air Conformity letter is prepared on Air Force letterhead, signed by 95 ABW/CEVC and a copy is included in the EA appendix.

While the Air Conformity analysis looks at only the project and NAAQS nonattainment areas and criteria pollutants in relation to the SIP, EIAP requires a more comprehensive analysis. The EIAP analysis includes addressing all the criteria pollutants, ozone precursors, hazardous air pollutants, air toxics, emissions of greenhouse gases (GHGs), permit requirements, direct and indirect impacts, and cumulative impacts from other similar projects. At Edwards, the Assessment Review Group (ARG) has been delegated the authority to approve CATEX documents and review and recommend approval of environmental assessments. The CATEX documents are signed by 95 ABW/CEVX, and EA/FONSIs are signed either by 95 ABW/CEV or 95 ABW/CE depending on the complexity or controversial status of the document.

Ambient Air Quality Standards

Air quality in a given location is defined by the concentration of various pollutants in the atmosphere. The U.S. EPA has set national air quality standards for seven common pollutants (also referred to as "criteria" pollutants). These standards, known as National Ambient Air Quality Standards (NAAQS), establish maximum pollutant levels that should not be exceeded. The NAAQS have been established for ozone, particulate matter equal to or less than10 microns (PM_{10}), fine particulate matter equal to or less than 2.5 microns ($PM_{2.5}$), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead.

The California Air Resources Board (CARB) has developed California Ambient Air Quality Standards for the same seven criteria pollutants plus visibility reducing particles, sulfates, hydrogen sulfide, and vinyl chloride. The criteria pollutants and state and federal standards are listed in Table A-5. The CARB and U.S. EPA track air quality on an ongoing basis and designate areas as either attainment or nonattainment for the specific criteria pollutant. An area can be designated as a basic, moderate, serious, severe, or extreme nonattainment area. If standards for pollutants are met in a particular area, the area is designated as attainment. Areas where standards have not been established or monitoring data do not

exist for certain criteria pollutants are considered unclassified. Unclassified areas are treated as attainment areas until proven otherwise.

Table A-5
National and California Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards	National Standards[(a)] Primary[(b,c)]	Secondary[(b,d)]
Ozone	1-hour	0.09 ppm	none	none
	8-hour	0.70ppm	0.08 ppm	same as primary
Carbon monoxide	1-hour	20 ppm	35 ppm (40 mg/m^3)	none
	8-hour	9 ppm	9 ppm (10 mg/m^3)	none
Nitrogen dioxide	1-hour	0.25 ppm	---	---
	Annual (arithmetic mean)	---	0.053 ppm (100 μg/m^3)	same as primary
Sulfur dioxide	1-hour	0.25 ppm	---	---
	3-hour	---	---	0.5 ppm (1,300 μg /m^3)
	24-hour	0.04 ppm	0.14 ppm	---
	Annual (arithmetic mean)	---	0.03 ppm	---
PM_{10}	24-hour	50 μg /m^3	150 μg /m^3	---
	Annual (arithmetic mean)	---	50 μg /m^3	same as primary
	Annual (geometric mean)	20 μg /m^3	---	---
$PM_{2.5}$	24-hour	---	65 μg /m^3	---
	Annual (arithmetic mean)	---	15 μg /m^3	same as primary
	Annual (geometric mean)	12 μg /m^3	---	---
Lead	30-day average	1.5 μg /m^3	---	---
	Quarterly average	---	1.5 μg /m^3	same as primary

Notes:
a Other than for ozone and those based upon annual averages, standards are not to be exceeded more than once per year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one.
b Concentrations are expressed first in the units in which they were promulgated. Equivalent units are given in parentheses.
c Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than 3 years after the U.S. EPA approves the state's implementation plan.
d Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after the U.S. EPA approves the implementation plan.

μg/m^3 micrograms per cubic meter
mg/m^3 milligrams per cubic meter
$PM_{2.5}$ particulate matter equal to or less than 2.5 microns in diameter
PM_{10} particulate matter equal to or less than 10 microns in diameter
ppm parts per million
U.S. EPA– U.S. Environmental Protection Agency

Regulatory Setting

Within the State of California, the authority to regulate stationary sources of air emissions is delegated by the U.S. EPA to local air pollution control and air quality management districts with state oversight provided by the CARB. Authority to regulate mobile sources of air emissions resides with CARB. Local districts enact rules and regulations to demonstrate State Implementation Plan goals.

In California, the CARB is responsible for enforcing air pollution regulations. The CARB has, in turn, delegated the responsibility of regulating stationary emission sources to local air agencies.

Edwards AFB is located within the jurisdiction of three local air districts: Kern County Air Pollution Control District (KCAPCD) in east Kern County, Mojave Desert Air Quality Management District (MDAQMD) in western San Bernardino County, and the Antelope Valley Air Quality Management District (AVAQMD) in northeastern Los Angeles County. The area is within the Mojave Desert Air Basin (MDAB). Most of Edwards AFB, including main base and the runways, is within the KCAPCD in east Kern County.

The MDAB is impacted by both ozone and fugitive dust emissions. Table A-6 presents a summary of the attainment status of the Edwards AFB area. These data show that the majority of the region is in non-attainment of both state and national standards for ozone and PM_{10} and in attainment or unclassified for CO, NO_2, and SO_2. With regard to the NAAQS, Edwards AFB is designated as a "moderate" ozone non-attainment area for 8-hour O_3 and is in attainment or unclassified for all other pollutants.

Table A-6

National/California Ambient Air Quality Standards

Attainment Designations in the Edwards AFB Area

County/Air Basin	Ozone	CO	NO_2	SO_2	PM_{10}
Kern/MDAB[(a)]	N/N	U*/U, A	U*/ U*	U*/ U*	U, U/N
San Bernardino/MDAB[(b)]	N, A/N	U*/A	U*/ U*	U*/ U*	N/N
Antelope Valley/MDAB	N/N	U*/A	U*/ U*	U*/ U*	U/N

Notes: Designation status: A=attainment, N=non-attainment, U=unclassified, and U*=unclassified/attainment.

a With regard to the CAAQS for CO, the eastern portion of the county, located in the MDAB, is unclassified while the western portion of the county is in attainment. With regard to the NAAQS for PM_{10}, the entire county within the MDAB is unclassified for the federal standard, except the Searles Valley Planning Area, which is non-attainment.

b With regard to the NAAQS for ozone, the western portion of San Bernardino County within the MDAB is non-attainment, and the eastern portion is in attainment.

CO carbon monoxide
MDAB Mojave Desert Air Basin
NO_2 nitrogen dioxide
PM_{10} particulate matter equal to or less than 10 microns in diameter
SO_2 sulfur dioxide

Source: California Environmental Protection Agency 2004.

Eastern Kern County is located on the western edge of the Mojave Desert and is separated from populated valleys and coastal areas to the west and south by several mountain ranges. These valleys and coastal areas are the major source of ozone precursor emissions affecting ozone exceedances within Kern County's part of the MDAB. Although the sources of pollution in eastern Kern County do not by themselves result in exceedances of the federal ozone standards, this region is largely impacted by ozone transport from both the San Joaquin Valley Air Basin and the South Coast Air Basin.

Ozone concentrations are generally highest during the summer and coincide with the period of maximum insolation, or the maximum amount of solar radiation striking the earth's surface. Maximum ozone concentrations tend to be regionally distributed due to the homogeneous dispersion of precursor emissions in the atmosphere.

Air Toxics

Air toxics are defined as any harmful chemical or group of chemicals in the air. Substances that are especially harmful to health, such as those considered under U.S. EPA's hazardous air pollutant program or California's AB 1807 and/or AB 2588 air toxics programs, are considered to be air toxics. Technically, any compound that is in the air and has the potential to produce adverse health effects is an air toxic.

At Edwards AFB, toxic substances are generated as a result of various processes including aircraft cleaning and painting, lubricating processes, the operation of internal combustion engines (e.g., AGE, boilers, turbine engines), and adhesives/sealant applications.

Assembly Bill 2588 requires facilities to submit emission inventory plans and reports to local air districts. These plans and reports track the emissions of the listed air toxics. Based on these reports, facilities are designated by the local air district as high, medium, or low priority. This designation is used to determine the specific requirements needed to comply with Assembly Bill 2588. In 1994, KCAPCD rated Edwards AFB as a medium priority facility. Edwards AFB has procedures that include the use of respirators and other mechanical devices to minimize exposure of workers to air toxics associated with the use of these chemicals. The MDAQMD has not established a rating for the Edwards AFB portion of the district. There are no sources of concern in AVAPCD.

Appendix A.1 Air Emission Analysis for Flight Test to the Edge of Space Environmental Assessment (48 Flights)

B-52G-H Aircraft Activity and Emissions for Edwards AFB

Aircraft Type	Engine Type	Number of Engines	Operation Cycle	Mode of Operation	Fuel Flow (lb/min)	Emission Factors (lb/1,000 lb of fuel)				
						ROGs	NOx	CO	SOx	PM
B-52G/H	TF33-3	8	LTO	Take Off	124.00	4.09	89.99	-	1.00	3.87
				Climb Out	104.00	9.36	49.17	13.17	1.00	10.30
				Approach	63.33	5.21	24.21	19.91	1.00	5.09
				Idle (Taxi-in)	15.00	81.82	1.25	85.55	1.00	1.12
				Idle (Taxi-out)	15.00	81.82	1.25	85.55	1.00	1.12
			TGO	Take Off	124.00	4.09	89.99	-	1.00	3.87
				Climb Out	104.00	9.36	49.17	13.17	1.00	10.30
				Approach	63.30	5.21	24.21	19.91	1.00	5.09

Number of Operations	Operation Cycle	Time in Mode (minutes)	Emissions (tpy)				
			ROGs	NOx	CO	SOx	PM
48	LTO	1.00	0.10	2.14	-	0.02	0.09
		2.00	0.37	1.96	0.53	0.04	0.41
		6.00	0.38	1.77	1.45	0.07	0.37
		15.00	3.53	0.05	3.70	0.04	0.05
		30.00	7.07	0.11	7.39	0.09	0.10
0	TGO	1.00	-	-	-	-	-
		1.50	-	-	-	-	-
		7.50	-	-	-	-	-
	Emissions (tpy)		***11.46***	***6.03***	***13.07***	***0.27***	***1.02***

B-52D Aircraft Activity and Emissions for Edwards AFB

Aircraft Type	Engine Type	Number of Engines	Operation Cycle	Mode of Operation	Fuel Flow (lb/min)	Emission Factors (lb/1,000 lb of fuel)				
						ROGs	NOx	CO	SOx	PM
B-52D	J57-19 (J57-43WB)	8	LTO	Take Off	129.67	0.10	11.00	1.50	0.54	1.74
				Climb Out	111.50	0.10	9.90	2.30	0.54	1.23
				Approach	30.83	9.20	3.60	24.00	0.54	0.29
				Idle (Taxi-in)	16.50	75.00	2.20	78.00	0.54	0.52
				Idle (Taxi-out)	16.50	75.00	2.20	78.00	0.54	0.14
			TGO	Take Off	129.67	0.10	11.00	1.50	0.54	1.74
				Climb Out	111.50	0.10	9.90	2.30	0.54	1.23
				Approach	30.83	9.20	3.60	24.00	0.54	0.29

Number of Operations	Operation Cycle	Time in Mode (minutes)	Emissions (tpy)				
			ROGs	NOx	CO	SOx	PM
48	LTO	1.00	0.00	0.27	0.04	0.01	0.04
		2.00	0.00	0.42	0.10	0.02	0.05
		6.00	0.33	0.13	0.85	0.02	0.01
		15.00	3.56	0.10	3.71	0.03	0.02
		30.00	7.13	0.21	7.41	0.05	0.01
0	TGO	1.00	-	-	-	-	-
		1.50	-	-	-	-	-
		7.50	-	-	-	-	-
	Emissions (tpy)		***11.03***	***1.14***	***12.11***	***0.13***	***0.14***

Appendix A.1 Air Emission Analysis for Flight Test to the Edge of Space Environmental Assessment (48 Flights)

KC-10 Aircraft Activity and Emissions for Edwards AFB

Aircraft Type	Engine Type	Number of Engines	Operation Cycle	Mode of Operation	Fuel Flow (lb/min)	Emission Factors (lb/1,000 lb of fuel)				
						ROGs	NOx	CO	SOx	PM
KC-10	F103-100/ F103-101	3	LTO	Take Off	348.5	1.0	34.0	0.2	1.0	-
				Climb Out	187.3	1.4	10.1	5.4	1.0	-
				Approach	187.3	1.4	10.1	5.4	1.0	-
				Idle (Taxi-in)	24.8	45.9	2.6	80.4	1.0	-
				Idle (Taxi-out)	24.8	45.9	2.6	80.4	1.0	-
			TGO	Take Off	348.5	1.0	34.0	0.2	1.0	-
				Climb Out	187.3	1.4	10.1	5.4	1.0	-
				Approach	187.3	1.4	10.1	5.4	1.0	-

Number of Operations	Operation Cycle	Time in Mode (minutes)	Emissions (tpy)				
			ROGs	NOx	CO	SOx	PM
48	LTO	1.00	0.03	0.85	0.01	0.03	-
		2.00	0.04	0.27	0.15	0.03	-
		6.00	0.11	0.82	0.44	0.08	-
		5.00	0.41	0.02	0.72	0.01	-
		10.00	0.82	0.05	1.44	0.02	-
0	TGO	1.00	-	-	-	-	-
		2.00	-	-	-	-	-
		6.00	-	-	-	-	-
	Emissions (tpy)		***1.41***	***2.01***	***2.74***	***0.16***	*-*

F-15 Aircraft Activity and Emissions for Edwards AFB

Aircraft Type	Engine Type	Number of Engines	Operation Cycle	Mode of Operation	Fuel Flow (lb/min)	Emission Factors (lb/1,000 lb of fuel)				
						ROGs	NOx	CO	SOx	PM
F-15	F100-220	2	LTO	Take Off (Mil)	176.33	0.10	27.00	0.90	1.00	0.34
				Climb Out	85.17	0.10	9.80	1.60	1.00	0.47
				Approach	50.00	1.90	6.70	5.80	1.00	0.27
				Idle (Taxi-in)	17.33	3.20	3.30	24.00	1.00	0.12
				Idle (Taxi-out)	17.33	3.20	3.30	24.00	1.00	0.12
				Afterburner	862.17	0.01	3.10	4.00	1.00	0.15
			TGO	Take Off	176.33	0.10	27.00	0.90	1.00	0.34
				Climb Out	85.17	0.10	9.80	1.60	1.00	0.47
				Approach	50.00	1.90	6.70	5.80	1.00	0.27

Number of Operations	Operation Cycle	Time in Mode (minutes)	Emissions (tpy)				
			ROGs	NOx	CO	SOx	PM
48	LTO	1.00	0.00	0.23	0.01	0.01	0.00
		1.00	0.00	0.04	0.01	0.00	0.00
		5.00	0.02	0.08	0.07	0.01	0.00
		15.00	0.04	0.04	0.30	0.01	0.00
		25.00	0.07	0.07	0.50	0.02	0.00
		-	-	-	-	-	-
0	TGO	1.00	-	-	-	-	-
		1.50	-	-	-	-	-
		7.50	-	-	-	-	-
	Emissions (tpy)		***0.13***	***0.46***	***0.88***	***0.06***	***0.01***

Appendix A.1 Air Emission Analysis for Flight Test to the Edge of Space Environmental Assessment (48 Flights)

F-16 Aircraft Activity and Emissions for Edwards AFB

Aircraft Type	Engine Type	Number of Engines	Operation Cycle	Mode of Operation	Fuel Flow (lb/min)	Emission Factors (lb/1,000 lb of fuel)				
						ROGs	NOx	CO	SOx	PM
F-16	F100-220	1	LTO	Take Off (Mil)	176.33	0.10	27.00	0.90	1.00	0.34
				Climb Out	85.17	0.10	9.80	1.60	1.00	0.47
				Approach	50.00	1.90	6.70	5.80	1.00	0.27
				Idle (Taxi-in)	17.33	3.20	3.30	24.00	1.00	0.12
				Idle (Taxi-out)	17.33	3.20	3.30	24.00	1.00	0.12
				Afterburner	862.17	0.01	3.10	4.00	1.00	0.15
			TGO	Take Off	176.33	0.10	27.00	0.90	1.00	0.34
				Climb Out	85.17	0.10	9.80	1.60	1.00	0.47
				Approach	50.00	1.90	6.70	5.80	1.00	0.27

Number of Operations	Operation Cycle	Time in Mode (minutes)	Emissions (tpy)				
			ROGs	NOx	CO	SOx	PM
48	LTO	1.00	0.00	0.11	0.00	0.00	0.00
		1.00	0.00	0.02	0.00	0.00	0.00
		5.00	0.01	0.04	0.03	0.01	0.00
		15.00	0.02	0.02	0.15	0.01	0.00
		25.00	0.03	0.03	0.25	0.01	0.00
		-	-	-	-	-	-
0	TGO	1.00	-	-	-	-	-
		0.50	-	-	-	-	-
		4.00	-	-	-	-	-
	Emissions (tpy)		***0.07***	***0.23***	***0.44***	***0.03***	***0.01***

F-18 Aircraft Activity and Emissions for Edwards AFB

Aircraft Type	Engine Type	Number of Engines	Operation Cycle	Mode of Operation	Fuel Flow (lb/min)	Emission Factors (lb/1,000 lb of fuel)				
						ROGs	NOx	CO	SOx	PM
F-18	F404-GE-400	2	LTO	Take Off (AB)	473.28	0.13	9.22	23.12	0.54	-
				Climb Out	134.71	0.31	25.16	1.05	0.54	2.81
				Approach	109.02	0.35	14.80	1.09	0.54	6.10
				Idle (Taxi-in)	10.40	58.18	1.16	137.34	0.54	12.38
				Idle (Taxi-out)	10.40	58.18	1.16	137.34	0.54	12.38
			TGO	Take Off (AB)	473.28	0.13	9.22	23.12	0.54	-
				Climb Out	134.71	0.31	25.16	1.05	0.54	2.81
				Approach	109.02	0.35	14.80	1.09	0.54	6.10

Number of Operations	Operation Cycle	Time in Mode (minutes)	Emissions (tpy)				
			ROGs	NOx	CO	SOx	PM
48	LTO	1.00	0.00	0.21	0.53	0.01	-
		1.00	0.00	0.16	0.01	0.00	0.02
		5.00	0.01	0.39	0.03	0.01	0.16
		15.00	0.44	0.01	1.03	0.00	0.09
		25.00	0.73	0.01	1.71	0.01	0.15
0	TGO	1.00	-	-	-	-	-
		0.50	-	-	-	-	-
		4.00	-	-	-	-	-
	Emissions (tpy)		***1.18***	***0.78***	***3.30***	***0.04***	***0.42***

T-38 Aircraft Activity and Emissions for Edwards AFB

Aircraft Type	Engine Type	Number of Engines	Operation Cycle	Mode of Operation	Fuel Flow (lb/min)	Emission Factors (lb/1,000 lb of fuel)				
						ROGs	NOx	CO	SOx	PM
T-38	J85-5A	2	LTO	Take Off	43.83	0.80	2.60	29.00	1.00	0.01
				Climb Out	24.33	3.50	2.30	43.00	1.00	0.01
				Approach	16.67	6.40	1.80	73.60	1.00	0.01
				Idle (Taxi-in)	7.50	30.00	1.30	178.00	1.00	-
				Idle (Taxi-out)	7.50	30.00	1.30	178.00	1.00	-
			TGO	Take Off	43.83	0.80	2.60	29.00	1.00	0.01
				Climb Out	24.33	3.50	2.30	43.00	1.00	0.01
				Approach	16.67	6.40	1.80	73.60	1.00	0.01

Number of Operations	Operation Cycle	Time in Mode (minutes)	Emissions (tpy)				
			ROGs	NOx	CO	SOx	PM
48	LTO	1.00	0.00	0.01	0.06	0.00	0.00
		1.00	0.00	0.00	0.05	0.00	0.00
		5.00	0.03	0.01	0.29	0.00	0.00
		10.00	0.11	0.00	0.64	0.00	-
		15.00	0.16	0.01	0.96	0.01	-
0	TGO	1.00	-	-	-	-	-
		0.50	-	-	-	-	-
		4.00	-	-	-	-	-
	Emissions (tpy)		***0.30***	***0.03***	***2.01***	***0.02***	***0.00***

Related Stationary Source Emissions (on ground)

Process Description	Fuel Type	Manufacturer	Rate/Size	Hours of Operation per Year	NOx	SOx	VOC	PM10
EUO Generator	Diesel	Mobile Electric	207 BHP	0	0	0	0	0
EUO Generator	Diesel	Detroit	148 BHP	0	0	0	0	0
EUO Generator	Diesel	Detroit	148 BHP	0	0	0	0	0
AGE Generator	Diesel	Cummins	187 BHP	384	0.79872	0.052608	0.06528	0.054144
ICE	Diesel	Detroit	148 BHP	0	0	0	0	0
EUO Generator	Diesel	Cummins	277 BHP	0	0	0	0	0
AGE AC	Diesel	Detroit	171 BHP	384	0.73344	0.048	0.5952	0.049536
EUO Generator	Diesel	Cummins	380 BHP	0	0	0	0	0
EUO Generator	Diesel	Cummins	380 BHP	0	0	0	0	0
EUO Generator	Diesel	Detroit	72 BHP	0	0	0	0	0
EUO Generator	Diesel	Cummins	605 BHP	0	0	0	0	0
				TOTAL Emissions in tons/year	***1.53216***	***0.10061***	***0.66048***	***0.10368***

Notes:

AC - air conditioner

AGE - aerospace ground equipment

BHP - brake horsepower

ICE - internal cumbustion engine

Appendix A.1 Air Emission Analysis for Flight Test to the Edge of Space Environmental Assessment (48 Flights)

Related Mobile Source Emissions (on ground)

Equipment or Vehicle Type	Rate of Emissions	Number of Equipment/Vehicles	Number of Miles	Number of Days	Number of Hours	NO_x Emission Factor	VOC Emission Factor	PM_{10} Emission Factor	Total NO_x Emissions	Total VOC Emissions	Total PM_{10} Emissions
LDGV	lb/mile	1	100	48	N/A	0.007	0.021	0.0003	0.0168	0.0504	0.0007
LDGT	lb/mile	1	100	48	N/A	0.003	0.007	0.0002	0.0072	0.0168	0.0005
LDDT	lb/mile	1	100	48	N/A	0.004	0.002	0.001	0.0096	0.0048	0.0024
HDGT	lb/mile	1	100	48	N/A	0.010	0.006	0.0003	0.0240	0.0144	0.0007
Diesel Forklift	lb/hour	1	N/A	48	4	1.691	0.152	0.139	0.1623	0.0146	0.0133
Shipping Truck	lb/hour	1	N/A	48	4	1.691	0.152	0.139	0.1623	0.0146	0.0133
								TOTAL Emissions in tons/year	***0.3823***	***0.1156***	***0.0310***

Notes:
LDGV - light-duty gasoline vehicle
LDGT - light-duty gasoline truck
LDDT - light-duty diesel truck
HDGT - heavy-duty gasoline truck
NOx - oxides of nitrogen
VOC - volatile organic compounds
PM10 - particulate matter equal to or below 10 microns
N/A - not applicable

Appendix A.1 Air Emission Analysis for Flight Test to the Edge of Space Environmental Assessment (48 Flights)

Any Year

	ROGs	NOx	CO	SOx	PM
Carrier Aircraft	11.46	6.03	13.07	0.27	1.02
Chase Aircraft	1.18	0.78	3.30	0.04	0.42
RSSE	0.66	1.53	N/A	0.10	0.10
RMSE	0.12	0.38	N/A	N/A	0.03
Total	13.41	8.73	16.37	0.41	1.58

Summary data includes the worst case emissions.

De minimis	100	100	N/A	N/A	N/A
Percent of *De minimis*	0.13	0.09	N/A	N/A	N/A

APPENDIX A.2 GREEN HOUSE GASES CALCULATIONS

Personnel Trip Calculations for Green House Gases

Emission Factors: Carbon dioxide emissions (metric tons for cars [average passenger car per year]) = 4.6 tons/year/car (ICF Consulting/U.S. EPA 2005)

It is assumed that a small mission program like this would employ approximately 75 personnel, so we will estimate using a conservative number of 100 personnel. Of those 100 personnel, 75 percent would come for other small programs coming to a close. Therefore an additional 25 percent would be added to the carbon neutral footprint. If all 25 new employees drove separate cars to the base, then 115 metric tons of carbon dioxide (4.6 X 25 = 115) would be added to the green house gas emission totals.

Test Vehicle Greenhouse Gas Calculations

Emission Factors: For JP-7 (AFRL 2008, NASA 1976)

Water Vapor 1.29/pound therefore: [(1.29 X 16,000)/2,000][48 flights] = 495.36 tons/48 flights or 495.36 tons X 2000 pounds/ton ÷ 2,200 pounds/metric ton = 450.32 metric tons

CO_2 3.14/pound therefore: [(3.14 X 16,000)/2,000][48 flights] = 1,205.76 tons/48 flights or 1,205.76 tons X 2000 pounds/ton ÷ 2,200 pounds/metric ton = 1,096.15 metric tons

Nitrogen Oxide 5 grams/kilogram of fuel therefore: [(5 grams) (0.454 pounds)(16,000 pounds)]/[2,000 pound/ton][48 flights]= 871.68 tons/48 flights or 871.68 tons X 2000 pounds/ton ÷ 2,200 pounds/metric ton = 792.44 metric tons

Note: 0.454 pound equals 1 kilogram

Table A.2-1 Greenhouse Gases Global Warming Potential (GWP)

Jet Fuel (JP-7)	Direct Product (Yes or No)	Quantity (metric tons)	Global Warming Potential (100 Year Time Horizon)	CO_2eq
Water vapor (steam)	Yes	450.32	0.73	328.73
Carbon dioxide	Yes	1,096.15	1	1,096.15
Methane	No	-	21	
Nitrous oxides	No	-	310	
Ozone	No*	-	1.06	
• Nitrogen oxides	Yes	792.44		839.98
Chlorofluorocarbons	No	-	140-23,900	
Carbon dioxide (VMT)	Yes	115	1	115
Total GWP				2,379.86

Note: While ozone is not directly produced from the combustion of the JP-7, the nitrogen oxides contribute indirectly to ozone production; consequently, the CO2eq for the nitrogen oxides produced have been calculated as a subset of the ozone GWP.
CO_2eq – Carbon dioxide equivalents
VMT vehicle miles travelled

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Appendix A.3 Carbon Neutral Program
CO_2 Offset Calculations for Recycled Commodities

	Cardboard bales	Newspaper bales	White paper bales	Computer paper bales	Color paper bales	#1 plastic bales	#2 plastic bales	#2 color plastic bales	Aluminum cans bales	Tin bales	Scrap metal tons		Emission Coefficients		Pounds/ ton	Total CO_2 Offsets
						Weight in Tons										
2000[c]	159.98	89.88	60.72	5.85	22.20	6.80	6.82	4.92	5.94	8.40	51.52					
2001[c]	149.175	69.72	35.2	2.6	17.02	5.78	6.6	4.92	5.61	6.6	45.63					
2002[c]	150.525	51.42	66.88	2.6	30.34	6.12	4.84	4.92	6.27	5.4	54.95					
2003[c]	172.8	72.36	75.68	0	25.16	7.48	4.4	7.38	5.94	6.6	75.73					
2004[c]	182.925	53.82	66.88	2.6	28.86	8.84	5.28	7.38	6.93	6.6	166.64					
2005[c]	200.475	69.39	55.44	0.65	48.84	11.005	5.72	4.92	7.26	63.91	214.49					
Total (tons)	1015.88	406.59	360.80	14.30	172.42	46.03	33.66	34.44	37.95	97.51	608.96					
Avg (tons) million (M)	169.3125	67.765	60.13333	2.38333333	28.73667	7.670833	5.61	5.74	6.325	16.25167	101.4933					
Btu/ton[a]	15.42	16.49	10.08	13.95	22.94	52.83	50.9	52.42	206.42	19.97	102.99					
MBtu	2610.7988	1117.44485	606.144	33.2475	659.2191	405.2501	285.549	300.8908	1305.6065	324.5458	10452.8	18,101.49	156.258 [b]	2,828,503.38	2,000.00	1,414.25
										Mbtu/barrel		5.80 [a]				
										gallons of oil		3,120.95	885.98 [b]	2,765,096.97	2,000.00	1,382.55

Note: Calculations of Total CO_2 offsets were developed using a emission coefficients for Mbtu per barrel and per gallon of Jet Fuel.
The lower offset was used to determine total CO_2 credits for the Carbon Neutral Program.

Source: a - ICF Consulting/U.S. EPA 2005
b - Energy Information Administration 2008
c - Data for tons of recycled commodities provided by J. Torres (Edwards AFB Recycling Contractor)

Appendix A.3 Carbon Neutral Program
Natural Sequestring

301,000.00	Acres	Edwards AFB
0.16	Percent of Acres that are Lakebeds, runways, ashhalt, in[a]	
48,160.00	Acres that are Lakebeds, runways, ashhalt, industrial	
252,840.00	Acres for Sequestering	
1,023,207,178.00	square meters	
950.00	CO_2 conversion factor in grams/square meter [b]	
972,046,819,100.00	grams	
453.59	grams/pound	
2,142,998,154.95	pounds	
2,000.00	pounds/ton	
1,071,499.08	Tons	CO_2

Source: a - Edwards AFB 2004 (INRMP Edwards AFB Plan 32-7064)
b - Smith, S. *et al*, Physiological Ecology of North American Desert Plants, 1997

B NOISE

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APPENDIX B –NOISE AND SONIC BOOM BACKGROUND DATA

Table B-1 Noise Definitions

Term	Definition
dB	The decibel (dB), a logarithmic unit that accounts for the large variations in amplitude, is the accepted standard unit measurement of sound.
dBA	A-weighted decibel scale (dBA). The dBA is commonly used to describe the sound level heard by humans.
dBC	C-weighted decibel scale (dBC). C-weighting is used as a descriptor of low-frequency impulse noise sources, such as gunshots, lightning, blast noise, and sonic booms.
DNL	Day-night average noise level (DNL). The DNL, often referred to as L_{dn}, has been adopted by federal agencies as the standard for measuring noise. The DNL is an A-weighted, 24-hour average of hourly averages. Each hourly average represents the sound energy of all the disparate sounds that occurred during that hour. Typically, different hours of the day would have different hourly averages. For this reason, and for standardization, the DNL is defined as the average of the 24 hourly averages of the day. The DNL or L_{dn} (a variant of L_{eq} that incorporates a 10-dB "penalty" for nighttime noise).
Leq	The long-term equivalent A-weighted sound level (L_{eq}).
CDNL	C-weighted day-night level (CDNL) is the C-weighted sound level averaged over a 24-hour period; with a 10-dB penalty added for noise occurring between 10:00 p.m. and 7:00 a.m. CDNL is similar to DNL, except that C-weighting is used rather than A-weighting. CDNL can also be expressed as $L_{cdn.}$
psf	Pounds per square foot (psf) measures the pressure level of C-weighted impulse noise called peak overpressure.
SEL	Sound exposure level (SEL) considers both the A-weighted sound level (AL) and duration of noise. SEL converts the total A-weighted sound energy in a given noise event with a given duration into a 1-second equivalent and, therefore, allows direct comparison between sounds with varying intensities and durations.
Sonic boom	The term sonic boom is commonly used to refer to the shocks caused by the supersonic flight of military aircraft and the Space Shuttle (up to Mach 27). Sonic booms generate enormous amounts of sound energy, sounding much like an explosion. Thunder is a type of natural sonic boom, created by the rapid heating and expansion of air.
CSEL	C-weighted sound exposure level (CSEL) is an SEL measurement based on the C-weighted level rather than the A-weighted level.
SPL	Sound pressure level (SPL) is a logarithmic scale, using decibel as units, and a reference pressure that corresponds approximately to the minimum audible sound pressure.
CNEL	Community noise equivalent level (CNEL) has been adopted by the State of California as the descriptor for measuring noise levels. The CNEL is similar to the DNL, except that it includes a 5 dB penalty for evening noise (7:00 p.m. to 10:00 p.m.) in addition to the 10 dB penalty for nighttime noise.

3.0 BACKGROUND

The FAA defines noise as sound that is unwanted and that disturbs routine activities and peace and quiet, and can cause annoyance. Three characteristics are used to measure noise: amplitude, frequency, and duration. Amplitude is the intensity of the noise and is described in units called decibels (dB). Frequency measures the number of wavelengths per time period; low frequency noises have fewer wavelengths per time period. Examples of high frequency noises include jet engines and train whistles. Low frequency noises can be blast noises and sonic booms. Duration is simply the length of time the noise lasts. Noise levels often change with time. Therefore, to compare noise levels over different time periods, several descriptors were developed to account for the time variances. Common definitions for quantifying noise are shown in Table B-1. These descriptors are used to assess and correlate the various effects of noise on humans, including land use compatibility, sleep and speech interference, annoyance, hearing loss, and startle effects.

3.1 PROJECT RELATED SONIC BOOMS

As a flight vehicle moves through the air at supersonic speeds, the air in front is displaced to make room for the vehicle and then returns once the vehicle passes. This causes what is called a sonic boom. In subsonic flight, the pressure wave (which travels at the speed of sound) precedes the vehicle and displaces the air around the vehicle. When a vehicle's speed reaches the speed of sound, it is said to be traveling at Mach 1. The pressure wave cannot travel faster than the speed of sound or precede the aircraft at Mach 1, and the parting process is abrupt, creating a noise. A shock wave is formed initially at the front of the vehicle when the air is displaced around it and lastly at the rear when a trailing shock wave occurs as the air recompresses to fill the void after passage of the vehicle. A sonic boom differs from most other sounds because it is impulsive (similar to a double gunshot), there is no warning of its impending occurrence, and the magnitude of the peak levels is usually higher. Sonic booms are typically measured in C-weighted decibels or by changes in air pressure, called peak overpressure; measured in pounds per square foot.

3.2 REGULATORY GUIDELINES

In 1980, the Federal Interagency Committee on Urban Noise (FICUN) published guidelines for considering noise in land use planning (FICUN 1980). Federal agencies have adopted these guidelines as the standard when making recommendations to local communities on land use compatibility issues. In 1982, the U.S. EPA published *Guidelines for Noise Impact Analysis*, based on the National Academy of Science's Committee on Hearing, Bioacoustics and Biomechanics (CHABA) proposed guidelines for the uniform description and assessment of the various noise environments associated with various projects. According to CHABA Guidelines, the long-term equivalent A-Weighted sound level (L_{eq}) and day-night

average noise level (DNL) were selected as the appropriate descriptors for noise because they reliably correlate with health and welfare effects. From data on community social surveys, DNL has been found to correlate with community annoyance, as measured in terms of percentage of exposed persons who are "highly annoyed". Exposure to sonic booms is typically measured as a C-Weighted day-night level (CDNL), on a C-weighted scale, rather than as a DNL, on an A-weighted scale. Correlation between DNL and CDNL has been established based on community reaction to impulsive sounds (CHABA 1981). The DOD has followed the recommendations of CHABA in describing high-intensity impulsive sounds, such as sonic booms and explosions, in terms of C-weighted sound exposure level. Table B-2 shows the relationship between the percent of the population highly annoyed by sound levels expressed as DNL (A-weighted) and CDNL (C-weighted). Based on federal standards, a DNL of 65 dBA or lower is considered to be acceptable (Figure 3-2); a DNL above 65 dBA but not exceeding 75 A-Weighted decibels (dBA) is normally unacceptable unless some form of noise attenuation is provided; a DNL higher than 75 dBA is unacceptable. Daily exposure to sonic booms of CDNL of 61 dB or less is comparable to the DNL 65 dBA significance level for non-impulsive noise.

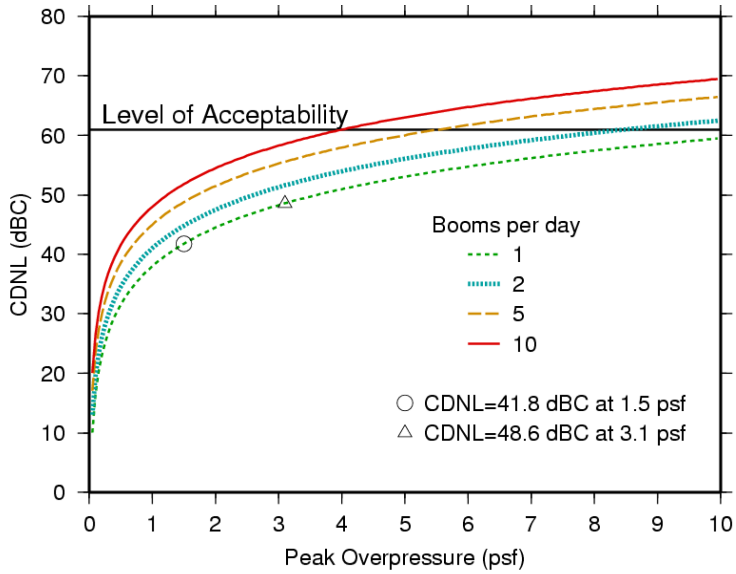
Table B-2

Relationship Between C-Weighted and A-Weighted Sound Levels and Percent of the Population Annoyed

CDNL (C-weighted)	% Highly Annoyed	DNL (A-weighted)
48	2	50
52	4	55
57	8	60
61	14	65
65	23	70
69	35	75

Notes: CDNL C-weighted equivalent of DNL
DNL day-night average noise level (A-weighted)

Source: Committee on Hearing, Bioacoustics and Biomechanics, Assembly of Behavioral and Social Sciences 1981



Source: 95ABW and AFFTC 2003

Figure 3-2

Relationship of CDNL to Peak Overpressure and Number of Daytime Sonic Booms

3.2.1.1 Noise Characteristics

The effect of noise on people can be classified into three general categories: (1) subjective effects of annoyance, nuisance, and dissatisfaction; (2) interference with activities such as speech, sleep, and learning; and (3) physiological effects such as anxiety or hearing loss. The sound levels associated with environmental noise generally produce effects only on categories 1 and 2. Whether noise is objectionable varies depending on the type of noise and the circumstances and sensitivities of the individual who hears it. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged. The human response to changes in decibel levels exhibits the following characteristics:

- A 3-dB change in sound level is considered a barely noticeable difference;
- A 5-dB change in sound level will typically result in a noticeable community response; and
- A 10-dB change, which is generally considered to be a doubling of the sound level, almost certainly causes an adverse community response (National Wind Coordinating Committee 1998).

Large fluctuations in noise are common, and even a 10-dB increase would be likely to cause an adverse

community response. Additionally, discrete noise is much more noticeable and more annoying at the same relative loudness level than other types of noise because it stands out against background noise.

3.2.1.2 Noise and Sonic Boom Measurement Relationships

Table B-3 shows the relationship between peak overpressure values used to measure the intensity of sonic booms and other impulse related noise in relation to values used to measure non-impulse noise. The projected maximum values for project-related noise (shaded in Table B-3) were calculated as shown in two noise and sonic boom studies (95ABW 2003, 2005).

Table B-3

Relationship Between Sonic Boom Overpressure in

Pounds per Square Foot (psf) and Other Noise Metrics in Decibels (dB)

Peak Overpressure (psf)	CSEL (dB)	Peak SPL (dB)	SEL (dB)
0.2	85.4	113.6	75.9
0.5	94.0	121.6	84.5
1.0	100.4	127.6	90.9
2.0	106.9	133.6	97.4
3.0	110.7	137.1	101.2
4.0	113.4	139.6	103.9
5.0	115.5	141.6	106.0
6.0	117.2	143.1	107.7
8.0	119.9	145.6	110.4
10.0	121.9	147.6	112.4
12.0	123.6	149.2	114.1
14.0	125.1	150.5	115.6
18.0	127.4	152.7	117.9
22.0	129.3	154.4	119.8
26.0	130.9	155.9	121.4
30.0	132.2	157.1	122.7

Source: 95ABW and AFFTC 2005b

In 1988 Haber and Nakaki completed a study to determine the possible damage to structures and artifact based on the nominal pounds per square foot peak overpressure of a sonic boom. Table B-4 describes the possible effects for the level of sonic booms anticipated by the Proposed Action or Alternatives for this project.

Table B-4
Possible Damage to Structures from Sonic Booms

Sonic Boom Peak Overpressure Nominal (psf)	Item Affected	Type of Damage
Less than 0.5	None.	
0.5–2 (Category 1)	Cracks in plaster	Fine; extension of existing; more in ceilings; over door frames; between some plaster boards.
	Cracks in glass	Rarely shattered; either partial or extension of existing.
	Damage to roof	Slippage of existing loose tiles/slates; sometimes new cracking of old slates at nail hole.
	Damage to outside walls	Existing cracks in stucco extended.
	Bric-a-brac	Those items carefully balanced or on edges can fall; fine glass, e.g., large goblets.
	Other	Dust falls in chimneys.
2–4 (Category 1)	Glass, plaster, roof tiles, ceilings	Failures show which would have been difficult to forecast in terms of their existing localized condition. Nominally in good condition.

Note: psf pounds per square foot
Source: Haber and Nakaki 1988.

A 1973 FAA-sponsored study was conducted using statistical analysis to determine the probability of glass breakage for various overpressures. If all flight paths are considered equally likely (that is, a flight vehicle could approach the structure from any direction), then the probability of breakage for good glass at various nominal peak overpressures is shown in Table B-5 (FAA 1973). If the flight vehicle were to approach from head-on or perpendicular to the plane of the window, which would be the worst condition, the probability would increase as shown in Table B-6.

Table B-5

Probability of Glass Breakage Under Flight Path from Any Direction

Overpressures (psf)	Probability of Breakage[a]
1	1 out of 1,000,000
2	23 out of 1,000,000

Note: a Number of panes that might be expected to break.

Table B-6

Probability of Glass Breakage from Head-on or Perpendicular Flight Path

Overpressures (psf)	Probability of Breakage[a]
1	23 out of 1,000,000[a]
2	75 out of 1,000,000
3	300 out of 1,000,000
4	1,200 out of 1,000,000
5	2,300 out of 1,000,000
6	4,000 out of 1,000,000

Note: a Number of panes that might be expected to break.

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Chapter 5

AVOIDANCE LOCATIONS

I. NUCLEAR POWER PLANTS

PLANTS	COORDINATES
CANADA	
Bruce	N44°22' W81°36'
Douglas Point	N44°20' W81°36'
Gentilly	N46°25' W72°22'
Nuclear Power Demonstration	N46°11' W77°39'
Pickering	N43°49' W79°04'
UNITED STATES	
Arkansas 1, 2–AR	N35°18'36" W93°13'51"
Beaver Valley 1, 2–PA	N40°37'19" W80°26'02"
Bellefonte–AL	N34°42'32" W85°55'36"
Big Rock Point–MI	N45°21'33" W85°11'41"
Braidwood 1, 2–IL	N41°14'37" W88°13'44"
Browns Ferry 1, 2–AL	N34°42'15" W87°07'07"
Brunswick 1, 2–NC	N33°57'30" W78°00'38"
Byron 1, 2–IL	N42°04'30" W89°16'55"
Callawy–MO	N38°45'40" W91°46'54"
Calvert Cliffs 1, 2–MD	N38°26'05" W76°26'31"
Catawba 1, 2–SC	N35°03'05" W81°04'10"
Clinton–IL	N40°10'19" W88°50'03"
Comanche Peak–TX	N32°17'52" W97°47'06"
Cook 1, 2–MI	N41°58'34" W86°33'59"
Cooper Station–NE	N40°21'43" W95°38'28"
Crystal River–FL	N28°57'26" W82°41'56"
Davis Besse–OH	N41°35'50" W83°05'11"
Diablo Canyon 1, 2–CA	N35°12'42" W120°51'16"
Dresden 1, 2, 3–IL	N41°23'23" W88°16'16"
Duane Arnold–IA	N42°06'02" W91°46'38"
Farley 1, 2–AL	N31°13'22" W85°06'45"
Fermi 1, 2–MI	N41°57'48" W83°15'31"
Fitzpatrick–NY	N43°31'26" W76°23'54"
Ft. Calhoun–NE	N41°31'15" W96°04'36"
GE Vallecitos–CA	N37°31'00" W121°48'30"
Ginna–NY	N43°16'40" W77°18'32"
Grand Gulf–MS	N32°00'27" W91°02'53"
Haddam Neck–CT	N41°28'55" W72°29'57"
Harris–NC	N35°38'00" W78°57'22"
Hatch 1,2–GA	N31°56'03" W82°20'40"
Hope Creek–NJ	N39°28'04" W75°32'17"
Humboldt Bay–CA	N40°44'31" W124°12'29"
Indian Point 1, 2, 3–NY	N41°16'17" W73°57'09"
Kewaunee–WI	N44°20'35" W87°32'10"
La Crosse–WI	N43°33'36" W91°13'42"
Lasalle County 1, 2–IL	N41°14'38" W88°40'15"
Limerick 1, 2–PA	N40°13'12" W75°35'24"
Maine Yankee–ME	N43°57'02" W69°41'46"
McGuire 1, 2–NC	N35°25'56" W80°56'54"
Millstone 1, 2, 3–CT	N41°18'31" W72°10'05"
Monticello–MN	N45°20'00" W93°50'54"
Nine Mile Point 1, 2–NY	N43°31'20" W76°24'36"
North Anna 1, 2–VA	N38°03'39" W77°47'26"
Oconee 1, 2, 3–SC	N34°47'30" W82°53'55"
Oyster Creek–NJ	N39°48'51" W74°12'23"
Palisades–MI	N42°19'20" W86°18'55"
Palo Verde 1, 2–AZ	N33°23'23" W112°51'43"
Peach Bottom 1, 2, 3–PA	N39°45'32" W76°16'09"
Perry–OH	N41°48'04" W81°08'36"
Pilgrim Station–MA	N41°56'40" W70°34'46"
Point Beach 1, 2–WI	N44°16'51" W87°32'10"
Prairie Island 1, 2–MN	N44°37'10" W92°37'59"
Quad Cities 1, 2–IL	N41°43'34" W90°18'36"
Rancho Seco–CA	N38°20'46" W121°07'08"
River Bend–LA	N30°45'26" W91°19'54"
Robinson–SC	N34°24'19" W80°09'31"
Salem 1, 2–NJ	N39°27'46" W75°32'09"
San Onofre 1, 2, 3–CA	N33°22'13" W117°33'25"
Seabrook–NH	N42°53'53" W70°51'05"
Sequoyah 1, 2–TN	N35°13'24" W85°05'16"
South Texas–TX	N28°47'42" W96°02'53"
St. Lucie 1, 2–FL	N27°20'55" W80°14'47"
Summer–SC	N34°17'45" W81°19'13"
Surry 1,2–VA	N37°09'56" W76°41'54"
Susquehanna 1, 2–PA	N41°05'30" W76°08'55"
Three Mile Island 1, 2–PA	N40°09'11" W76°43'30"
Trojan–OR	N46°02'27" W122°53'04"
Turkey Point 3, 4–FL	N25°26'06" W80°19'53"
Vermont Yankee–VT	N42°46'49" W72°30'57"
Vogtle 1, 2–GA	N33°08'31" W81°45'53"
Waterford 3–LA	N29°59'42" W90°28'16"
Watts Bar–TN	N35°36'10" W84°47'25"
WNP 2–WA	N46°28'17" W119°19'59"
Wolf Creek–KS	N38°14'20" W95°41'20"
Yankee Rowe–MA	N42°43'41" W72°55'29"
Zion 1, 2–IL	N42°26'44" W87°48'08"

II. RADIOACTIVE WASTE SITES

A. West Valley, NY; 1.5 NM radius circle centered on N42°27'00" W78°38'45".

B. Morris Operation, IL; N41°22'53" W88°16'32".

C. Humboldt Bay, CA; N40°42'28" W124°12'33".

D. LaCrosse, WI; N43°33'30" W91°13'50".

III. SUPERSONIC FLIGHT

In accordance with AFI 13-201, paragraph 3e(2), the following are designated HQ USAF Specified Critical areas and shall be avoided by one-half (1/2) NM FOR EACH 1,000 feet of flight altitude up to a maximum of 30 NM.

A. Fort Jefferson National Monument, Florida.

B. Chaco Canyon National Monument; Aztec Ruin National Monument; and Gran Quivira National Monument, New Mexico.

C. Canyon DeChelly National Monument; Wupatki National Monument; and Navajo National Monument, Arizona.

D. Rainbow Bridge National Monument and Natural Bridges National Monument, Utah.

E. Death Valley National Monument, California.

Trojan-OR
WNP 2-WA
Chicag
Ft. Calhoun-NE
Humboldt Bay RWS-CA
Humboldt Bay-CA
Cooper Station-NE
Utah
Rancho Seco-CA
Wolf Creek- KS
GE-Vallecitos-CA
Natural Bridges National Monument
Death Valley National Monumen
Navajo National Monument
Aztec Ruin National Monument
Diablo Canyon 1,2 - CA
Canyon Dechelly National Monument
Chaco Canyon National Monument
Los Angeles
Wupatki National Monument
Gran Quivira National Monument
San Onofre 1,2,3-CA
Phoenix
Dallas
Palo Verde 1,2-AZ
Comanche Peak-TX
San Diego
Houston
San Antonio
South Texas-TX
Avoidance Areas
Nuclear Power Plants
Radioactive Waste Sites
National Monuments/Parks
Image © 2008 DigitalGlobe
Image © 2008 TerraMetrics
Gulf of Califor
Image NASA
© 2008 Europa Technologies
©2007 Google™
Pointer 38°36'00.63" N 109°19'03.26" W
Streaming 100%
Eye alt 1888.49 mi

The following appendices are **only** found on the compact disk.

APPENDIX B

APPENDIX B.1 NOISE AND SONIC BOOM ANALYSIS FOR HYPERSONIC CORRIDORS AT EDWARDS AIR FORCE BASE

APPENDIX B.2 NOISE AND SONIC BOOM ANALYSIS FOR EXTENDED RANGE HYPERSONIC CORRIDORS AT EDWARDS AIR FORCE BASE

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APPENDIX B.3

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C AIRSPACE MANAGEMENT AND AIR SAFETY

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APPENDIX C – SUPPLEMENTAL AIRSPACE MANAGEMENT AND AIR SAFETY DATA

Table 3-12

Definitions of Airspace Categories and Classes

Category	Definition	Examples
Controlled	Airspace used by aircraft operating under Instrument Flight Rules (IFR) that require different levels of air traffic service.	Altitudes above Flight Level (FL) 180 (18,000 feet above mean sea level [MSL]) Airport Traffic Areas, Airport Terminal Control Areas, Jet Routes, Victor Routes
Uncontrolled	Airspace primarily used by general aviation aircraft operating under Visual Flight Rules (VFR)	As high as 14,500 feet above MSL
Special Use	Airspace within which specific activities must be confined or access limitations are placed on nonparticipating aircraft	Restricted Areas Military Operations Areas (MOAs)
Other	Airspace not included under controlled, uncontrolled, or special use categories	Military Training Routes (MTRs)
Classes	Figure 3-5 shows what the different classes of airspace look like.	
A	Generally, Class A airspace extends from 18,000 feet above MSL up to and including FL 600, including the airspace overlying the waters within 12 nautical miles (NM) of the coast of the 48 contiguous states and Alaska; and designated international airspace beyond 12 NM of the coast of the 48 contiguous states and Alaska within areas of domestic radio navigational signal or Air Traffic Control (ATC) radar coverage, and within which domestic procedures are applied.	

Table 3-12, Page 1 of 2

Table 3-12 (Continued)

Definitions of Airspace Categories and Classes

Category Classes	Definition	Examples
B	Generally, Class B airspace extends from the surface to 10,000 feet above MSL surrounding the nation's busiest airports in terms of IFR operations or passenger enplanements. The configuration of each Class B airspace area is individually tailored and consists of a surface area and two or more layers (some Class B airspace areas resemble upside-down wedding cakes), and is designed to contain all published instrument procedures once an aircraft enters the airspace. An ATC clearance is required for all aircraft to operate in the area, and all aircraft that are so cleared receive separation services within the airspace. The cloud clearance requirement for VFR operations is "clear of clouds."	
C	Generally, that airspace from the surface to 4,000 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower, are serviced by a radar approach control, and that have a certain number of IFR operations or passenger enplanements. Although the configuration of each Class C airspace area is individually tailored, the airspace usually consists of a 5 NM radius core surface area that extends from the surface up to 4,000 feet above the airport elevation, and a 10 NM radius shelf area that extends no lower than 1,200 feet up to 4,000 feet above the airport elevation.	Beale AFB, Burbank-Glendale-Pasadena Airport
D	Generally, that airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower.	
E	Generally, if the airspace is not Class A, Class B, Class C, or Class D, and it is controlled airspace, it is Class E airspace.	
G	Class G airspace is a mantle of low lying airspace beginning at the surface. Class G is airspace that is completely uncontrolled. This low lying blanket of uncontrolled airspace only ends when it meets Class B, C, D, or E airspace. Think of Class G as "ground" airspace. It covers almost the entire country. In very remote areas it has an upper limit at 14,500 feet above MSL. However, over the vast majority of area of the country it has an upper limit that follows the contour of the ground.	

Table 3-12, Page 2 of 2

Special Use Airspace

Special use airspace consists of airspace wherein activities must be confined because of their nature, or wherein limitations are imposed upon aircraft operations that are not a part of those activities, or both (FAA 2005). The types of special use airspace affected by the proposed action include:

- **Restricted Areas.** Restricted areas contain airspace identified by an area on the surface of the Earth within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Activities within these areas are confined to permitted activities and limitations are imposed upon all other aircraft operations. Restricted areas generally are used to contain hazardous military activities. The term “hazardous” implies, but is not limited to, weapons deployment (these areas also are referred to as controlled firing areas and may be either live or inert), aircraft testing, and other activities that would be inconsistent or dangerous with the presence of non-participating aircraft. There are five restricted areas within the R-2508 Complex. The carrier aircraft would take off and land at Edwards AFB, which is within restricted area R-2515. The flight vehicle would land at Edwards AFB after entering restricted area R-2515 at or above 60,000 feet above MSL.

- **Military Operating Areas.** MOAs are airspace of defined vertical and lateral limits that have been established in order to separate certain military activities from IFR traffic (FAA 2005a). MOAs include airspace designated for non-hazardous military activities and are established outside of controlled airspace below Flight Level (FL)180. Typical activities that occur in MOAs include military pilot training, aerobatics, and combat tactics training. When MOAs are in use, non-participating aircraft flying under IFR clearances are directed by air traffic control to avoid the MOA. However, even when an MOA is in use, entry into the area by VFR aircraft is not prohibited, and flight by non-participating aircraft can occur on a see-and-avoid basis.

All alterations and temporary closures of existing airspace are processed through the FAA. The FAA reviews and approves all such modifications. Use of restricted airspace requires the issuance of a Notice to Airmen (NOTAM), which provides notice to all aircraft of the restricted airspace via air traffic control. (FAA 2004). Table 3-13 shows the special use airspace potentially affected by flight vehicles landing at Edwards AFB.

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The following appendices are **only** found on the compact disk.

APPENDIX C

APPENDIX C.1 QUANTITATIVE RISK ANALYSIS FOR HYPERSONIC CORRIDORS AT EDWARDS AIR FORCE BASE

APPENDIX C.2 QUANTITATIVE RISK ANALYSIS FOR EXTENDED RANGE HYPERSONIC CORRIDORS AT EDWARDS AIR FORCE BASE

APPENDIX C.3 EXPOSURE ANALYSIS FOR HYPERSONIC CORRIDORS AT EDWARDS AIR FORCE BASE

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Sortie Data from AFFTC AFTO-781 Database

Sorties by Aircraft Type for Indicated Years Data from AFFTC AFTO-781 Database						
Acft Type	**CY99**	**CY00**	**CY01**	**CY02**	**Total**	**Avg Yr**
F-16	3,178	3,208	2,821	2,979	12,186	3,047
T-38	2,772	2,794	2,333	1,929	9,828	2,457
F-15	1,291	1,099	947	851	4,188	1,047
C-135*	900	814	477	861	3,052	763
C-12	415	457	485	500	1,857	464
F-18	376	625	479	463	1,943	486
T-39	266	295	323	216	1,100	275
C-130	241	113	171	102	627	157
B-1	86	153	327	268	834	209
F-22	157	154	338	565	1,214	304
B-52	85	57	119	99	360	90
B-2	48	20	87	19	174	44
CV-22	0	12	0	9	21	5
Total	9,815	9,801	8,907	8,861	37,384	9,346
All Acft	*11,200*	*11,609*	*11,112*	*10,987*	*44,908*	*11,227*
Diff	*1,385*	*1,808*	*2,205*	*2,126*	*7,524*	*1,881*
% Diff	*12%*	*16%*	*20%*	*19%*	*17%*	*17%*

Dec-03

CY99	CY00	CY01	CY02	
11,200	*11,609*	*11,112*	*10,987*	AFTO totals
15,692	14,286	13,024	12,777	R-2515 totals
0.713739	0.812614	0.853194	0.859905	% AFTO of R-2515

3.239452	total percent for 4 years
4	# of years
0.809863	Avg %/per year

40,157	Total R-2515 1990
32,522	Calculated Sorties for 1990

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D DISTRIBUTION LIST

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APPENDIX D—DISTRIBUTION LIST

DISTRIBUTION LIST

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412 TW/TSDL
Edwards AFB, CA 93524

Antelope Valley Air Quality Management District
43301 Division St., Ste. 206
Lancaster, CA 93639-4409
Attn: Eldon Heaston. APCO
(Or) Bret Banks, Operations Manager

Bureau of Land Management
Barstow Area Office
2601 Barstow Road
Barstow, CA 92311-3221

Bureau of Land Management
Ridgecrest Area Office
300 S. Richmond Road
Ridgecrest, CA 93555-4436

California Department of Fish and Game
1416 Ninth Street
Sacramento, CA 95814

California Department of Parks and Recreation
P.O. Box 942896
Sacramento, CA 94296

City of Lancaster
Planning Department
44933 N. Fern Ave.
Lancaster, CA 93534

Congressman McKeon
Antelope Valley Field Office
1008 W. Avenue M-14 #E-1
Palmdale, CA 93551

Congressman Thomas
4100 Empire Dr.
Bakersfield, CA 93309

Edwards AFB Base Library
95 SPTG/SVMG
5 West Yeager Blvd.
Building 2665
Edwards AFB, CA 93524-1295

Federal Aviation Administration
Western Pacific Region
Attn: Charles Lieber
Airspace Management Branch
15000 Aviation Boulevard
Lawndale, CA 90261

Inyo County Free Library
Furnace Creek Branch
PO Box 568
Death Valley, CA 92328

Jerry Schwartz
Environemental Lead
Surveillance Systems Engineering Group
FAA, AND-402
800 Independence Avenue SW, Room 511
Washington, DC 20591

John O'gara
Head of Environmental Planning
Environmental Office
Code 8G0000D
#1 Administration Circle
Naval Air Weapons Station
China Lake, CA 93555

Kern County APCD
Attn: David Jones
2700 M Street, Suite 302
Bakersfield, CA 93301-2370

Kern County Department of Planning
and Development Services
2700 M Street, Suite 100
Bakersfield, CA 93301-2323

Kern County Library
Boron Branch
26967 20 Mule Team road
Boron, CA 93516

Kern County Library
California City Branch
9507 California City Boulevard
California City, CA 93505

Kern County Library
Mojave Branch
16916-1/2 Highway 14
Mojave, CA 93501

Kern County Library
Ridgecrest Branch
131 East Las Flores Ave
Ridgecrest, CA 93555

Kern County Library
Wanda Kirk Branch (Rosamond)
3611 Rosamond Boulevard
Rosamond, CA 93560

Kern River Valley Library
7054 Lake Isabella Boulevard
Lake Isabella, CA 93240
Attn: Karen Liefield, Branch Supervisor

Los Angeles County Library
Lancaster Branch
601 W. Lancaster Boulevard
Lancaster, CA 93534

Mojave Desert AQMD
14306 Park Ave.
Victorville, CA 92392-2310
Attn: Eldon Heaston, APCO

Muhammad Bari
Director of Public Works
HQ NTC Ft. Irwin
Attn: AFZJ-PW-EV
PO Box 105097
Building 285
Fort Irwin, CA 92310-5097

Native American Heritage Commission
915 Capital Mall, Room 364
Sacramento, CA 95814

Office of Historic Preservation
State Historic Preservation Officer
PO Box 942896
Sacramento, CA 94296-0001

San Bernardino County
Land Use Services Department
Planning Division
385 N. Arrowhead Ave., 1st Floor
San Bernardino, CA 92415-0182

Sierra Club
Antelope Valley Group
P.O. Box 901875
Palmdale, CA 93590

Timbisha Shoshone Tribe
P.O. Box 206
Death Valley, CA 92328-0206
Attn: Pauline Esteves, Chairperson

USDA Forest Service
Pacific Southwest Region
Sequoia National Forest
900 West Grand Avenue
Porterville, CA 93257

U.S. Department of the Interior
National Park Service
Death Valley National Park
PO Box 579
Death Valley, CA 92328

U.S. Department of the Interior
Fish and Wildlife Service
Ventura Field Office
2493 Portola Road, Suite B
Ventura, CA 93003-7726

U.S. Environmental Protection Agency
Region IX, EIS Review Section
75 Hawthorne Street
San Francisco, CA 94105
US Senator Barbara Boxer
501 I Street, Suite 7-600
Sacramento CA 95814

US Senator Diane Feinstein
United States Senate
331 Hart Senate Office Building
Washington, DC 20510

DISTRIBUTION FOR STATE CLEARINGHOUSES

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Arizona State Clearinghouse
3800 N. Central Avenue
Fourteenth Floor
Phoenix, Arizona 85012

Office of Planning and Research
California State Clearinghouse
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Sacramento, CA 95812-3044

Heather Elliott
Department of Administration
State Clearinghouse
209 E. Musser Street, Room 200
Carson City, Nevada 89701

Ken Hughes
Local Government Division
Room 201 Bataan Memorial Building
Santa Fe, New Mexico 87503

Jim Boyd
Division of Community Services
600 East Boulevard Ave, Dept 105
Bismarck, North Dakota 58505-0170

Denise S. Francis
Director, State Grants Team
Governor's Office of Budget and Planning
P.O. Box 12428
Austin, Texas 78711

Carolyn Wright
Utah State Clearinghouse
Governor's Office of Planning and Budget
State Capitol - Room 114
Salt Lake City, Utah 84114

Sandy Ross
Department of Administration and Information
2001 Capitol Avenue, Room 214
Cheyenne, WY 82002

DISTRIBUTION FOR STATE LIBRARIES

Arizona State Library, Archives and Public Records
1700 West Washington, Suite 200
Phoenix, AZ 85007

Office of the State Librarian
State Librarian, Susan Hildreth
Deputy State Librarian, Stacey Aldrich
Stanley Mosk Library and Courts Building
914 Capitol Mall, Room 220
Sacramento, CA 95814

Colorado State Library
201 East Colfax Avenue, Room 309
Denver, CO 80203

Idaho Commission for Libraries
325 W. State St.
Boise, ID, 83702

State Library of Kansas
Capitol Building, Room 343-N
300 SW 10th Ave,
Topeka, KS 66612-1593

Montana State Library
P.O. Box 201800
1515 East 6th Avenue
Helena MT 59620-1800

Nebraska Library Commission
The Atrium
1200 N Street, Suite 120
Lincoln, NE 68508-2023

Nevada State Library & Archives
100 North Stewart Street,
Carson City, NV 89701- 4285

New Mexico State Library.
1209 Camino Carlos Rey
Santa Fe, NM 87507

North Dakota State Library
604 E. Boulevard Avenue
Bismarck, ND 58505-0800
Oklahoma Department of Libraries
200 N.E. 18th St.
Oklahoma City 73105

Oregon State Library
250 Winter St. NE
Salem, Oregon 97301-3950

South Dakota State Library
Dan Siebersma, State Librarian
Mercedes MacKay Building
800 Governors Drive
Pierre, SD 57501-2294

Texas State Library and Archive Commission
P.O. Box 12927
Austin, TX 78711

Utah State Library
250 N. 1950 W. Suite A
Salt Lake City, Utah 84116 – 7901

State Publications Depository
Washington State Library
PO Box 42470
Olympia, WA 98504-2470

Wyoming State Library
516 S. Greeley Hwy.
Cheyenne, WY 82002

E RESPONSE TO COMMENTS

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APPENDIX E

RESPONSE TO COMMENTS

The draft Environmental Assessment for Flight Test to the Edge of Space was distributed to public libraries and other potential stakeholders within the area of concern as listed in Appendix D. Additionally, two websites provided online access to the Draft EA. One website www.edge-of-space.org received 236 hits and 2 e-mail comments. The Air Force website http://bsx.edwards.af.mil/environmental/ received 13 hits; no comments were received. A total of four comments were received; one supporting Alternative B, one opposed to any proposed action, one concerned about ground shaking that could be caused by the sonic boom reaching the ground, and one from the State Clearinghouse, indicating that no comments from any state agencies were received. Responses to each of the comments are addressed in the attached Response to Comments Table. A copy of the public comments are also attached.

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Draft Environmental Assessment for Flight Test on the Edge of Space

Comment #	Page/Line #	Commenter	Comment
Response			
1	General	Private Citizen, Gary Veatch	realname: Gary Veatch email: garyv7161msn.com Category: Private Citizen Other: Chapter: General Comments Summary/Finding of No Significant Impact (FONSI)2.0 Description of the Proposed Action and Alternatives3.0 Affected Environment/Environmental Consequences4.0 Cumulative Impacts B1: Submit Date: 11-14-2008 Address: 10602 NE Holladay Portland, Oregon 97220 Comments: I recommend the adoption of alternative "B" (Flights only over the Pacific Ocean except for launch & recovery). This recommendation is based on the need to mitigate noise pollution over the United States land mass and to protect the health and safety of the general population should mishaps occur. To my knowledge, the Environmental Assessment document did not address the nature of the fuels to be used; materials, toxicity, combustion by-products, special storage requirements, health hazards of spill, environmental impacts of contamination, etc. The report was non-specific, and by inference to comparisons with the fuels used by commercial aviation, implied the materials were the same. Yet, fuels used by hypersonic vehicles could be completely different and could be extremely hazardous. The Environmental Assessment is incomplete if it does not specifically address any and all fuels that will or potentially might be used. Gary Veatch 11-14-2008

Draft Environmental Assessment for Flight Test on the Edge of Space
Response
Noted. Thank you for your comments and recommendation. Noise mitigation was addressed in Section 3.2. Health and Safety analyses was conducted and documented in the two Quantitative Risk Analysis studies (Appendix C.1 and C.2). The nature of the fuel was addressed. As indicated in Table 3-5, the type of fuel used in the analysis is JP-7 (jet fuel). This type of fuel has been used in the past at Edwards AFB where the fueling and storage would occur. No new requirements and standard management procedures would be used, consequently, no potential significant impacts as indicated in Chapter 2, “Issues and Concerns Considered but Eliminated from Further Study – Hazardous Materials/Hazardous Waste/Solid Waste”. The combustion byproducts of burning jet fuel are indicated in Table 3-5 and in Appendix A.2. Burning JP-7 results in energy, water vapor, carbon dioxide, and nitrogen oxides; consequently the issue with burning JP-7 is an Air Quality issue which was addressed in Section 3.1. As you noted, other fuels could be completely different; accordingly, if alternative fuels were selected then the Air Force would require supplemental analysis before the fuel and flight test was authorized.

Comment #	Page/Line #	Commenter	Comment
2	General	Private Citizen, Todd Sullivan	realname: L Todd Sullivan email: ToddSullivan503@comcast.net Category: Private Citizen Other: Chapter: General Comments Summary/Finding of No Significant Impact (FONSI)1.0 Need for the Proposal B1: Submit Date: 11/14/08 Address: PO Box 86491, Portland Oregon 97286 Comments: What is WRONG with you people? What is wrong with the people who funded you? The World, as we know it, is going to DIE of rising heat due to

Draft Environmental Assessment for Flight Test on the Edge of Space

			the "Greenhouse Effect" of increasing high-altitude concentrations of carbon dioxide reflecting radiant heat back to the Earth's surface. It is not a theory any longer, it is a proven fact. And you people want to burn colossal amounts of high-altitude oxygen, creating colossal new amounts of high-altitude carbon dioxide? Again, what is WRONG with you? And all for what? To prove that you can make a hypersonic aircraft, even though it is preposterously unlikely to ever succeed as a controllable, manned vehicle? Just what exactly is the actual NEED for such a thing? How many humans will ever be inconvenienced by the lack of such a hypersonic vehicle burning up the atmosphere? I am utterly opposed to further research such as this. I f you go ahead and do it, I can only hope that you live long enough to see what you have done to the planet..............Todd Sullivan

Response

Noted. Thank you for your comments. An analysis of the effects on greenhouse gases was addressed in Section 3.1

Comment #	Page/Line #	Commenter	Comment
3	General	Terry Roberts, Director, California State Clearinghouse	The State Clearinghouse submitted the above named Joint Document to selected agencies for review. The review period closed on November 14, 2008, and no state agencies submitted comments by that date. This letter acknowledges that you have complied with State Clearinghouse review requirements for draft environmental documents, pursuant to the California Environmental Quality Act. (A copy of the Governor's Office of Planning and Research letter is attached)

Response

Noted with pleasure.

Comment #	Page/Line #	Commenter	Comment
4	General	Private Citizen, Edlyn Clevenger	-----Original Message----- From: 95 ABW/PAE Sent: Monday, December 01, 2008 12:30 PM To: Hatch, Gary L Civ USAF AFMC 95 ABW/PA Subject: FW: Concern: Hypersonic test flights

Draft Environmental Assessment for Flight Test on the Edge of Space

			-----Original Message----- From: eecm1@myuw.net [mailto:eecm1@myuw.net] Sent: Friday, November 28, 2008 10:18 AM To: 95 ABW/PAE Subject: Concern: Hypersonic test flights Hello, I am but a humble trail worker at Kings Canyon National Park. Even though the closing date for public comment has passed, I thought I might add something to the discourse, that perhaps all involved are already aware of. I work on building and maintaining backcountry trails. Sometimes I am required to work in large talus fields, and the majority of the time I am at the foot of large talus fields. When low flying, sound barrier breaking, aircraft come through, the boom shakes the ground. When one is standing in the middle of a talus field and the ground is made to shake, one hears rocks shifting, rolling, etc,. Just one shifting or rolling rock could mean serious or fatal injury to those of us working amongst them. I take responsibility for my choice to work in this risky environment, however it would be nice for the military to consider this effect that sonic booms can have. My intention is to add this impact into the processes of consideration when conducting this hypersonic project. Thank you very much for your time and consideration. Sincerely, Edlyn Clevenger

Response

Noted. Thanks for your comment and concern. The Air Force has analyzed the potential effects of the sonic booms that would result from these test flights. The flight path of the faster than the speed of sound vehicle would have to be within 40 miles of your location for you to hear or feel the low level sonic boom. Kings Canyon National Park is located approximately 150 miles from Edwards AFB. At that distance the flight test vehicles would be slowing down to land at Edwards AFB, would be at or above 90,000 feet mean sea level, and the intensity of the sonic boom would be approximately 0.3–0.5 pounds per square inch. From Table B-4 the effects at that intensity are “none”. The R-2508 Users Guide states

Draft Environmental Assessment for Flight Test on the Edge of Space

"Low-flying aircraft over National Parks and Wilderness areas is an extremely sensitive issue. All aircrews SHALL maintain a minimum altitude of 3,000 feet AGL over, and a lateral distance of 3,000 feet (approximately ½ nautical mile) from the Death Valley National Monument, Sequoia & Kings Canyon National Parks, and the Domeland and John Muir Wilderness Areas".

			No Additional Comments Were Received

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Knight, Jim

From: www@edge-of-space.org
Sent: Saturday, November 15, 2008 2:05 AM
To: comments@edge-of-space.org
Subject: Data posted to form 1 of http://www.edge-of-space.org/New_Web/Submit Comments Page.htm

****

realname: Gary Veatch
email: garyv7161msn.com
Category: Private Citizen
Other:
Chapter: General CommentsSummary/Finding of No Significant Impact (FONSI)2.0 Description of the Proposed Action and Alternatives3.0 Affected Environment/Environmental Consequences4.0 Cumulative Impacts
B1: Submit

Date:

11-14-2008

Address:

10602 NE Holladay
Portland, Oregon 97220

Comments:

I recommend the adoption of alternative "B" (Flights only over the Pacific Ocean except for launch & recovery). This recommendation is based on the need to mitigate noise pollution over the United States land mass and to protect the health and safety of the general population should mishaps occur.

To my knowledge, the Environmental Assessment document did not address the nature of the fuels to be used; materials, toxicity, combustion by-products, special storage requirements, health hazards of spill, environmental impacts of contamination, etc. The report was non-specific, and by inference to comparisons with the fuels used by commercial aviation, implied the materials were the same. Yet, fuels used by hypersonic vehicles could be completely different and could be extremely hazardous. The Environmental Assessment is incomplete if it does not specifically address any and all fuels that will or potentially might be used. Gary Veatch 11-14-2008

Knight, Jim

From: www@edge-of-space.org
Sent: Friday, November 14, 2008 8:44 PM
To: comments@edge-of-space.org
Subject: Data posted to form 1 of http://www.edge-of-space.org/New_Web/Submit Comments Page.htm

****
realname: L Todd Sullivan
email: ToddSullivan503@comcast.net
Category: Private Citizen
Other:
Chapter: General CommentsSummary/Finding of No Significant Impact (FONSI)1.0 Need for the Proposal
B1: Submit

Date:

11/14/08

Address:

PO Box 86491, Portland Oregon 97286

Comments:

What is WRONG with you people? What is wrong with the people who funded you? The World, as we know it, is going to DIE of rising heat due to the "Greenhouse Effect" of increasing high-altitude concentrations of carbon dioxide reflecting radiant heat back to the Earth's surface. It is not a theory any longer, it is a proven fact. And you people want to burn colossal amounts of high-altitude oxygen, creating colossal new amounts of high-altitude carbon dioxide? Again, what is WRONG with you?

And all for what? To prove that you can make a hypersonic aircraft, even though it is preposterously unlikely to ever succeed as a controllable, manned vehicle? Just what exactly is the actual NEED for such a thing? How many humans will ever be inconvenienced by the lack of such a hypersonic vehicle burning up the atmosphere?

I am utterly opposed to further research such as this. I f you go ahead and do it, I can only hope that you live long enough to see what you have done to the planet..............Todd Sullivan

STATE OF CALIFORNIA
GOVERNOR'S OFFICE *of* PLANNING AND RESEARCH
STATE CLEARINGHOUSE AND PLANNING UNIT

ARNOLD SCHWARZENEGGER
GOVERNOR

CYNTHIA BRYANT
DIRECTOR

November 17, 2008

Gary Hatch
U.S. Air Force Flight Test Center/95th ABW
95ABW/EMXC
5 E. Popson Avenue, Bldg. 2650A
Edwards AFB, CA 93524-1130

Subject: Flight Test to the Edge of Space
SCH#: 2008104002

Dear Gary Hatch:

The State Clearinghouse submitted the above named Joint Document to selected state agencies for review. The review period closed on November 14, 2008, and no state agencies submitted comments by that date. This letter acknowledges that you have complied with the State Clearinghouse review requirements for draft environmental documents, pursuant to the California Environmental Quality Act.

Please call the State Clearinghouse at (916) 445-0613 if you have any questions regarding the environmental review process. If you have a question about the above-named project, please refer to the ten-digit State Clearinghouse number when contacting this office.

Sincerely,

Terry Roberts

Terry Roberts
Director, State Clearinghouse

Document Details Report
State Clearinghouse Data Base

SCH#	**2008104002**
Project Title	Flight Test to the Edge of Space
Lead Agency	U.S. Air Force

Type	**JD**	Joint Document

Description Note: Joint Document: Environmental Assessment/FONSI

The U.S. Air Force proposes to conduct up to 48 flight tests annually at very high altitudes (up to 264,000 feet above sea level) over the western U.S. and Pacific Ocean. These flight tests would reach speeds faster than the speed of sound and land at Edwards AFB, CA. This EA serves as a foundation for a first flight in 2011 and would be re-evaluated after 2015. This EA evaluates 6 alternatives addressing the launch, flight, and landing phase at Edwards AFB.

Lead Agency Contact

Name	Gary Hatch				
Agency	U.S. Air Force Flight Test Center/95th ABW				
Phone	(661) 277-1454	***Fax***			
email					
Address	95ABW/EMXC 5 E. Popson Avenue, Bldg. 2650A				
City	Edwards AFB	***State***	CA	***Zip***	93524-1130

Project Location

County	Kern, Los Angeles, San Bernardino						
City	Lancaster						
Region							
Lat / Long							
Cross Streets							
Parcel No.							
Township		***Range***		***Section***		***Base***	

Proximity to:

Highways	58
Airports	Edwards
Railways	
Waterways	
Schools	
Land Use	

Project Issues Air Quality; Economics/Jobs; Geologic/Seismic; Noise; Public Services; Solid Waste; Toxic/Hazardous; Vegetation; Water Supply; Wildlife; Landuse; Cumulative Effects; Other Issues

Reviewing Agencies Resources Agency; Department of Fish and Game, Headquarters; Cal Fire; Office of Historic Preservation; Department of Parks and Recreation; Department of Water Resources; Office of Emergency Services; Caltrans, Division of Aeronautics; Caltrans, Division of Transportation Planning; Air Resources Board, Airport Projects; Regional Water Quality Control Bd., Region 6 (Victorville); Native American Heritage Commission

Date Received	10/02/2008	***Start of Review***	10/02/2008	***End of Review***	11/14/2008

Note: Blanks in data fields result from insufficient information provided by lead agency.

-----Original Message-----
From: eecm1@myuw.net [mailto:eecm1@myuw.net]
Sent: Friday, November 28, 2008 10:18 AM
To: 95 ABW/PAE
Subject: Concern: Hypersonic test flights

Hello, I am but a humble trail worker at Kings Canyon National Park. Even though the closing date for public comment has passed, I thought I might add something to the discourse, that perhaps all involved are already aware of. I work on building and maintaining backcountry trails. Sometimes I am required to work in large talus fields, and the majority of the time I am at the foot of large talus fields. When low flying, sound barrier breaking, aircraft come through, the boom shakes the ground. When one is standing in the middle of a talus field and the ground is made to shake, one hears rocks shifting, rolling, etc,. Just one shifting or rolling rock could mean serious or fatal injury to those of us working amongst them. I take responsibility for my choice to work in this risky environment, however it would be nice for the military to consider this effect that sonic booms can have. My intention is to add this impact into the processes of consideration when conducting this hypersonic project. Thank you very much for your time and consideration.

Sincerely,

Edlyn Clevenger

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kumazawa patti
Wednesday, 12/03/2008

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General | Specific | Audit | Categories | Ratings | References | Versions

Event	Date	User
Permissions Changed	12/02/2008 02:15 PM	BSX_OKM
Move	12/02/2008 08:15 AM	kumazawa patti
Version Opened	12/01/2008 11:08 AM	public
Version Opened	12/01/2008 11:08 AM	public
Version Opened	11/20/2008 04:40 PM	public
Version Opened	11/20/2008 04:40 PM	public
Version Opened	11/20/2008 04:40 PM	public
Version Opened	11/20/2008 03:34 PM	public
Version Opened	11/20/2008 03:34 PM	public
Version Opened	11/20/2008 03:34 PM	public
Version Opened	11/17/2008 03:19 PM	public
Version Opened	11/17/2008 08:09 AM	public
Version Opened	10/28/2008 06:49 AM	public
Version Opened	10/28/2008 06:48 AM	public
Version Opened	10/27/2008 05:52 PM	public
Version Added	10/22/2008 08:04 AM	kumazawa patti
Create	10/22/2008 08:04 AM	kumazawa patti